University of Alberta
Printing Department

THE UNIVERSITY OF ALBERTA

THE RELATIONSHIP OF INTROVERSION-EXTRAVERSION TO PHYSICAL PERSISTENCE

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF ARTS

FACULTY OF PHYSICAL EDUCATION

EDMONTON, ALBERTA

MAY, 1966

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "The Relationship of Introversion-Extraversion to Physical Persistence," submitted by Paul Richard Joseph Brady in partial fulfilment of the requirements for the degree of Master of Arts.

ABSTRACT

The purpose of this study was to investigate the relationship of introversion-extraversion to the amount of work decrement, the amount of reminiscence, the amount of persistence and the rate of work decrement. Seventy-two freshman male subjects at the University of Alberta were selected on the basis of their scores on the Maudsley Personality Inventory.

Statistically significant differences were found between introverts and extraverts in the amount of work decrement and amount of persistence of certain tasks used for the experiment. However, other findings were not in line with the hypothesized outcome of the study.

The reasons for the inconsistency in performance from task to task for the different personality groups were discussed. Pain tolerance and stimulus-response style may have accounted for the lack of clarity in the results.

Recommendations were made that should guide further investigation in this area.

ACKNOWLEDGEMENTS

The author wishes to express his sincere appreciation to his committee members, Dr. M. L. Howell, Dr. R. B. Alderman and Dr. W. A. S. Smith for their patience, guidance and expert criticism throughout the writing of this thesis.

The author is also indebted to Dr. W. R. Morford who stimulated the idea that created the study.

I would like to express my gratitude to the subjects that participated in this experiment.

Last, but not least, I must sincerely thank my wife Sherry for the help and patience she provided throughout the course of this study.

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

Regardless of the type of event an athlete trains for, extensive emphasis is placed upon conditioning. Conditioning entails varying lengths of repetitive and fatiguing physical exertion. In order for an athlete to be successful he must be persistent and withstand the physical pain that precedes the success afforded by his efforts. Too often, physical educators and coaches tend to overlook the possibility of improving current training procedures through a more profound understanding of the personality structure of athletes involved. A better understanding of the personality structure of athletes may eventually lead to the planning of more satisfying and efficient training schedules for a larger number of individuals.

Recent investigations by Eysenck (16,27) have indicated that the personality dimension introversion-extraversion may be particularly worthy of extensive study with respect to the compatability of the type of work to be engaged in by the individual. Eysenck's theory (27), which stems from Hull (44), states that any overt response produces an inhibitory potential that is a drive to rest. The amount and the rate of inhibition build-up among individuals appears to vary differentially according to their personality structure. Relationships between extraversion as measured by the Maudsley Personality Inventory and the amount

and rate of inhibition build-up have been demonstrated (16,22,23,24, 25). However, the significance of these relationships has been subject to much debate (2,59,65,66,67).

Other approaches to personality and its relationship to physical work are found in the literature. Hempill, Hall and Crookes (39) have shown that the amount of work done on an ergograph, the onset of subjective fatigue and the amount of impairment (physiological fatigue) are related to the personality of the individual. Studies on persistence and pain tolerance indicate that a meaningful relationship exists between personality and fatigue.

In the main these studies have dealt only with motor tasks that require minimum physical effort on the part of the individual. Also, many conflicting results arise from these studies. However, the conflicts appear to be due to methodological differences rather than absolute evidence contrary to the original theory (44).

There seems to emerge from the above findings a need for further consideration of Eysenck's theory (27) and its applicability to repetitive performance on a gross motor task. At present this is the most important study indicated, however, other phenomena such as pain tolerance and persistence are so closely related, that their examination is warranted.

The Problem

The purpose of this study is to investigate the extent to which individuals, classified according to the personality trait introversion-extraversion, vary in their ability to perform a variety of local and

general repetitive physical tasks of a tiring nature as determined by the following measures:

1. the amount of work decrement;
2. the amount of recovery (reminiscence);
3. the amount of persistence; and
4. the rate of work decrement.

Subsidiary Problem

A secondary problem is the determination of the size of the correlations between each of the tasks within each of the traits.

Hypotheses[1]

It is predicted for the present experiment that:

1. extraverts will show significantly more work decrement than introverts;
2. extraverts will show significantly more recovery (reminiscence than introverts);
3. introverts will be significantly more persistent than extraverts; and
4. extraverts will have a significantly faster rate of work decrement than introverts.

Justification

Three factors justify a study of this nature. First, the

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[1]The main source of reference used in determining the outlined hypotheses was Eysenck's revision of his theory as outlined in reference (27) and under the initial sub-heading in the review of the literature for this paper.

experimental confusion regarding optimal testing conditions (27) using the pursuit rotor specify a need for extensive research using the recommended optimal test conditions (27). Second, there is a need in the field of physical education to examine the theoretical importance of Eysenck's (27) dynamic personality theory (27) and Hull's postulates of reactive inhibition (44) as related to physical tasks of a gross physical nature. Last, it is of considerable importance in planning practice schedules that physical educators and coaches develop a deeper understanding of the player's personality in relation to the type and amount of work to be performed.

Delimitation of the Study

1. The sample to be studied is limited to a segment (72 healthy subjects from the ages of eighteen to twenty-one years) of the total male freshman population of the University of Alberta.

2. This study is limited by the tasks used to measure the required criterion.

3. This study is further limited by the use of the Maudsley Personality Inventory as a measure of introversion-extraversion.

4. The statistical procedures used to analyze the data further limit the study.

5. The only task selected to measure learning is the pursuit rotor.

6. This study is restricted to measure only those parameters delineated by the main and subsidiary problems.

Assumptions

1. It is assumed that the Maudsley Personality Inventory is an adequate measure of the personality traits introversion-extraversion.

2. It is assumed that the selected tasks are valid and reliable indicators of the parameters investigated.

Definition of Terms

Introvert. For the present experiment introverts are those subjects scoring on the most extreme portion of the introvert dimension of the Maudsley Personality Inventory.

Extravert. For the present experiment extraverts are those subjects scoring on the most extreme end of the extravert dimension of the Maudsley Personality Inventory.

Interpolated Rest. The ten minutes between the work trials was the interpolated rest period.

Persistence. The persistence score for each subject is determined as follows: on tasks two and three it is the total time in seconds the subject can maintain the microswitch open; on task four, persistence is determined by the number of revolutions completed at the end of the ten minute pre-rest work period; on task five persistence is determined by the number of step-ups completed by the end of five minutes pre-rest work.

Work Decrement. The difference between the first minute score and the last minute during the work period is taken as the amount of work decrement. This score is determined on tasks four and five only. On task four the units are revolutions and on task five the units are

step-ups.

Amount of Recovery. The amount of recovery is the change in performance that results from an interpolated rest pause. It is determined by a reminiscence measure on tasks one, four and five. The units are seconds, revolutions and step-ups, respectively.

Reminiscence. Reminiscence is considered to be that increment in performance resulting from an interpolated rest period. It is determined several different ways. First, it is determined by the last ten-second pre-rest score minus the first ten-second post-rest score. Second, it is determined by the average of the last three ten-second periods pre-rest minus the first ten-second post-rest period. Third, it is determined by the difference between the last thirty seconds pre-rest and the first thirty seconds post-rest.

Work Trial. The period wherein the subject is engaged in performing the required tasks is considered a work trial.

General Physical Work.[1] The work required to perform the fifth task is considered to be of a general nature.

Local Physical Work.[2] The work required to perform tasks one, two, three and four is considered to be local in nature.

Repetitive Physical Work.[3] The work required to perform tasks one, four and five is considered repetitive. This work is assumed to involve the emitting of a stimulus repetitively in order to produce a response.

[1,2,3,4]The reader should refer to methodology for a more comprehensive explanation of the nature of these tasks.

Constant Physical Work.[4] This is the work required to perform tasks two and three. This work is assumed to involve the emitting of a continuous stimulus in order to maintain a response.

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[4]The reader should refer to methodology for a more comprehensive explanation of the nature of these tasks.

CHAPTER II

REVIEW OF THE LITERATURE

Literature Pertaining to the Extent of Relationship Existing Between Reminiscence and Extraversion

Eysenck (15) concluded from an early study on patients and the effects of cortical inhibition and figural after-effects that: hysterics developed satiation and figural after-effects more quickly than did dysthymics; hysterics developed stronger satiation and figural after-effects than dysthymics; hysterics developed more persistent satiation and figural after-effects than dysthymics.[1]

Eysenck (16), in a later study, examined his earlier conclusions. Using a traditional pursuit rotor, revolving at a rate of seventy-two revolutions per minute, he tested fifty university students ages nineteen to twenty-five years old. The procedure involved administering the Maudsley Personality Inventory to the subjects and then testing them on the pursuit rotor. Each session was thirty consecutive ten-second trials (five minutes), followed by a ten-minute rest period, then a five-minute post-rest work period, another ten-minute rest and a final five-minute work period. The criterion test (Maudsley Personality Inventory) had a split half reliability of $r = .77$ on the extraversion- introversion scale. A correlation, $r = .44$, between two reminiscence scores,

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[1]Hysterics were considered to be extraverted neurotics; dysthymics were considered to be introverted neurotics.

reached significance at the five per cent level of probability. Eysenck (16) accounted for the low reliability with two reasons. First, there was a high variance attached to any single ten-second score. Second, conditioned inhibition ($_{S}I_{R}$) accumulates and is a function of reactive inhibition (I_{R}). The personality correlates reveal an r = .29 (significant at the two per cent level) between extraversion and the first reminiscence measure. The correlation r = .22 between extraversion and the sum of the two reminiscence scores was insignificant at the five per cent level. Eysenck (16) commented that it was not possible to account for the amount of reminiscence shown, by personality factors. However, he further commented that a significant relationship did exist between reminiscence and personality traits.

Eysenck (23) reported findings on several reminiscence scores and their relationship to extraversion as evidence supporting his theory (16). He found product-moment correlations between the extraversion scale and ten reminiscence measures to be nearly all positive (r = .19, .01, .11, -.07, .27, .08, -.03, .01, .21). The total performance correlation was r = -.01. Only one correlation, on a one-tailed test, departed significantly from zero, but eight of ten were in the predicted direction. The mean reminiscence scores over all trials correlated r = .21 with extraversion (significance not reported). A factor analysys confirmed the general picture with the second factor having positive loadings on extraversion (r = .54) and the reminiscence measures; one, six, seven, eight, nine and ten (r's of .29, .42, .21, .18, .46, .22, respectively). This evidence failed to be very convincing for support of a theory. Eysenck, in another study (24), stated that when the

relevant results of Eysenck (1956), Star (1957), Lynn (in press), and Claridge, were averaged, the mean correlation between reminiscence and extraversion was r = .36.

Eysenck (24) tested two hundred forty engineering apprentices separated into eight groups on the basis of their Maudsley Personality Inventory scores, different lengths of pre-rest practice and duration of rest. He concluded that reminiscence scores on the pursuit rotor were a function of the duration of practice, duration of rest and the degree of introversion-extraversion. Eysenck (24) suggested that in order to get optimum effects only short trials on the pursuit rotor should be used.

Eysenck and Eysenck (25) cited results supporting optimal conditions as an important determinant of reminiscence measures. Using sixty-two industrial apprentices tested on the spiral after-effect, they found that massed practice shortened after-effect and long rests produced greater reminiscence effects. Correlations with personality were slight, but in the predicted direction. Only one significant correlation was reported between extraversion and reminiscence (r = .55, quantitative statistics were not reported).

Lynn (51) added further evidence to the prediction that extraverts demonstrated more reminiscence than introverts. He tested forty male university students on the following two hypotheses: first, a positive correlation between extraversion and reminiscence exists; second, there is a tendency for extraverts to show more work decrement with massed practice on an inverted alphabet printing task. The product-moment correlations between reminiscence and extraversion was r = .42,

which reached significance at the five per cent level. Work decrement and extraversion correlated r = .21, which just fell short of significance at the same level. The mean scores for the two groups on the inverted alphabet printing task illustrated the tendency for extraverts to slow down and show greater reminiscence. The introvert's mean score on the two tasks was 5.10 with a standard deviation of 2.28. The extravert's mean score was 10.42 with a standard deviation of 4.98. In toto, the correlations supported Eysenck's theory (16), those not reaching significance being in the predicted direction.

Lynn (51), in a summary, discussed some reasons for the inconsistencies in findings by different researchers. First, Lynn reported that Rechtschaffen (66) used the Guilford R-scale which correlates r = .50 with the Maudsley Personality Inventory. Second, methods of assessing reactive inhibition are important but great differences exist in the present assessment measures. Third, Rechtschaffen (66) found low correlations which were due to insufficient rest periods (one minute rest between trials). Last, conditioned inhibition in Rechtschaffen's study (66) was not studied under optimal conditions (27).

Venables and Tizard (80) and Venables (79) conducted experiments involving clinical patients and repetitive work. Their results supported Eysenck's hypothesis (16) that extraverts demonstrate greater amounts of work decrement than introverts. Venables (79) concluded that the factor responsible for decrement and reminiscence was reactive inhibition.

In a recent study, Eysenck (27) revised his theory (16). The revision included an elaboration of the operation of the theory and the correct methodology to test the link between extraversion and

reminiscence. Stated briefly the theoretical framework is as follows:

1. Massed practice produces a negative drive state called reactive inhibition (I_R).

2. I_R grows until it equals drive (D), the D, under which the subject is working.

3. When this critical point is reached, performance ceases and an involuntary rest pause (I.R.P.) occurs.

4. During this I.R.P. inhibition dissipates, and performance begins again when sufficient I_R has been dissipated.

5. I_R accumulates again until another I.R.P. occurs, and performance continues by fits and starts in this fashion.

6. A programmed rest pause allows I_R to dissipate, so that performance after the rest pause is better than before; the resulting improvement is called reminiscence.

7. If the rest pause is long enough to allow the complete dissipation of I_R, then reminiscence is an accurate measure of I_R.

8. After the critical point has been reached where I_R = D, reminiscence is an accurate measure of D.

However, some complicating features are present within this theoretical framework:

9. I.R.P.'s act as reinforcement for the act of resting in the general test situation.

10. Through this reinforcement, conditioned inhibition is set up. Conditioned inhibition is a habit that does not dissipate.

11. After programmed rest, I.R.P.'s do not occur for some time as I_R has to grow again from its depleted state; this failure of conditioned inhibition to be reinforced causes it to extinguish.

12. This extinction of conditioned inhibition is shown in performance as a marked and prolonged post-rest upswing in performance.

Optimal conditions for testing this theory are:

A. Pre-rest practice should not be too long, because:

1. extraverts develop I_R quickly, introverts do so more slowly

and therefore maximum I_R should be reached earlier by the extraverts than by the introverts so that an early rest pause would capitalize on this hypothetical difference in rate of development;

2. long pre-rest practice allows much ${}_SI_R$ to develop; the extinction of this in the post-rest period may interfere with the measure of reminiscence.

B. The programmed rest period should be long enough to allow all of the accumulated I_R to dissipate. If the rest period is short, then introverts, dissipating I_R more quickly, may erroneously be thought to have more I_R than extraverts, who dissipate it more slowly.

C. The reminiscence score is determined by subtracting a pre-rest score from a post-rest score. These scores should be determined by taking periods of practice as short as possible. Post-rest scores can be contaminated by:

1. extinction of ${}_SI_R$ and,

2. possible warm-up effects, and the only way to minimize these effects is to have very short periods of measurement immediately succeeding rest,

3. the suggestion that the test should be carried out near the beginning of the learning curve on the particular task chosen was predicted on two considerations: (i) later stages different subjects have different amounts of ${}_sH_R$ and ${}_sE_R$ (reaction potential), this, combined with the ceiling effects, obscures the picture; (ii) long previous practice on a task is likely to have led to the accumulation of ${}_SI_R$, the extinction of which interferes with reminiscence.

Eysenck (27) reports that in order to obtain significant results on the pursuit rotor it is necessary to have five minutes pre-rest practice, a ten-minute rest period and the reminiscence score calculated in terms of ten-second work periods. However, it must be remembered that any ten-second trial is highly unreliable and therefore this procedure for calculation of reminiscence may be of doubtful value. Eysenck (27) further states that if twenty-second intervals are used the results become insignificant. This happened with Ray (65). He also failed to start the pursuit rotor two and one-half seconds before the beginning of the post-rest trials and when this is not done the subject on the last pre-rest trial starts with an obvious advantage over his performance on the first post-rest trial. Eysenck (27) suggests several factors that must be controlled in future experiments:

1. Optimum combination of length of pre-rest practice.
2. Scoring procedure.
3. Length of rest pause.
4. Level of performance at which measurement is taken.
5. Most suitable type of performance.

Commenting on up-to-date studies Eysenck (27) cites that the correlations are quite low ($r = .2$ or $.3$). However, this may have been the result of failure to conduct experiments at optimal conditions or the fact that the Maudsley Personality Inventory failed to be a perfectly valid criterion for investigation of extraversion. However, regardless of the method of measurement or criterion used these results concur with the prediction that reminiscence is greater in extraverts than in

introverts. The different results obtained by different authors (2,27, 16,65,66,67) are due to experimental design and personality measures which are difficult to determine at present.

Eysenck (27) added additional evidence to his theory of differential susceptibility to reactive inhibition in the present study. He stated that assuming the growth of I_R is limited by the quantity of D under which the subject is working, it would follow that extraverts cannot accumulate a greater quantity of inhibition than introverts unless their drive is greater. As there is no reason to believe that there are any differences in drive between the groups, the prediction that extraverts should show higher degrees of reminiscence than introverts (19) would seem unfounded. Eysenck disproved this on the basis of two hypotheses:

1. Inhibition develops more quickly, and
2. dissipates less quickly in extraverts than in introverts.

He graphically illustrated these hypotheses, when he showed that I_R build-up in extraverts was twice as fast building up and twice as long dissipating in extraverts than introverts. If this was true it would lead to three consequences:

1. I.R.P.'s are twice as long for extraverts,
2. work intervals between I.R.P.'s are half as long for extraverts,
3. I.R.P.'s begin after half the length of practice for extraverts as they do for introverts. The results clearly demonstrated that these consequences did occur.

According to Eysenck (27), extraverts are consistently found inferior to introverts in performance. This inferior performance pre-rest should lead to a permanent decrement due to the fact that the extravert spends more time in I.R.P. However, the introvert should accumulate more ${}_{S}I_{R}$ due to a larger number of reinforcements during unit time and the hypothetically greater rate of conditioning of introverts. At present, it is difficult to say if one of these factors is stronger or whether they cancel out. Whatever the final conclusion, states Eysenck (27), it would seem that extraverts should show a higher degree of reminiscence, not because, as in the original version of the theory, they had accumulated more I_R than introverts, but because they were on the average more likely to be in a state of not working (I.R.P.) during the pre-rest period, which in determining reminiscence is subtracted from the post-rest period. On this revised hypothesis Eysenck (18) says that overall differences between extraverts and introverts on reminiscence scores can still be expected.

In a resume, Eysenck (27) pointed out some interesting facts that may have led to difficulties in interpretation of results. He says that the assumption throughout that there are no differences in drive between extraverts and introverts is questionable. This is difficult to disprove or verify in terms of a Hullian system where drive in subjects would be indexed normally in terms of performance or reminiscence. Until a satisfactory method for quantifying drive levels is discovered, the differences in reminiscence scores between groups cannot be adequately accounted for by this theory (27). Conditions

surrounding the experimental method may at present be accounting for reminiscence differences.

From the evidence presented in the above section introverts would be predicted to perform at a superior level on motor performance tasks.

Literature Pertaining to a Lack of Relationship of Reminiscence to Extraversion

Ray (65) designed a study to test the generality of Eyzenck's predictions (16): "Extraverts develop reactive inhibition faster and dissipate it slower than introverts; and, extraverts demonstrate more reminiscence than introverts." He tested two hundred forty subjects selected from five hundred fifteen students on the basis of the extreme scores they received on the Maudsley Personality Inventory. The subjects were subjected to pursuit rotor work interspersed with a variety of rest intervals prior to a second work period. The prediction that introverts would have a significantly higher peformance level on a continuous work task than would extraverts was not upheld, although the difference in slopes of the performance curves of these two groups was significant. In some respects this study supported Eysenck(16), in that reactive inhibition build-up was faster in extraverts than in introverts. But failure of the extravert group to show significantly more reminiscence than the introvert group suggested that Eysenck's formulation (16) regarding the rate of dissipation of reactive inhibition in the two groups was incorrect. Eysenck (27) suggested that an alternate answer to this discrepancy might be the fact that Ray (65) failed to test under optimal conditions.

Rechtschaffen (66) correlated the scores of ninety-six volunteer subjects on the Guilford R-scale with a visual after-effect measure and the amount of reactive inhibition contracted during performance on the inverted alphabet printing task. The results illustrated that introversion-extraversion (R-scale) scores were not significantly correlated with either the amount of visual after-effects or the reactive inhibition measures. An additional analysis was made comparing thirty-five subjects with the highest R-scores at both extremes. The two groups did not differ significantly on either the after-effect or the reactive inhibition measures.

Rechtschaffen and Bookbinder (67) mentioned that Eysenck (15) hypothesized that extraverts developed greater neural satiation than introverts and offered evidence which they interpreted as refuting this hypothesis. Eysenck (15) used the dual criteria of psychiatric diagnosis and scores on the Rathymia scale (R-scale) (35) to define introversion-extraversion. The selected subjects were given tests designed to measure kinesthetic after-effects, as a measure of neural satiation. Eysenck's (15) results demonstrated a tendency for extraverts to develop greater kinesthetic after-effects. Rechtschaffen and Bookbinder (67) found results contrary to Eysenck's hypothesis but their results were non-significant.

Becker (2), in an intensive experimental investigation of the constructs used by Eysenck (15) and previously mentioned authors, (67), found results opposing Eysenck's (15) hypotheses and offered an explanation for existing confusion in this area. Becker (5) tested thirty-two

males and thirty females, randomly selected from a population of one thousand introductory psychology students. In assessing introversion-extraversion he administered the Guilford's Temperament Schedules, Cattell's Revised 16 PF (form A and B) and Eysenck's extraversion scale (M.P.I.) to the subjects. The assessment of cortical inhibition involved calculating the pursuit rotor reminiscence score, response alteration score, three satiation measures, and a variety of basal measures (2). Evaluation of the experimental measures indicated that three factors were responsible for the results obtained. First, the presence of a basal inhibition factor that may include some aspects of satiation was found. Second, no factor corresponding to Eysenck's concept of reactive cortical inhibition which includes satiation and reactive inhibition measures was discovered. Third, a lack of convincing evidence for the existence of unitary traits fitting the definitions of satiation or reactive inhibition was indicated. He concluded that there is no evidence for a relationship between any kind of inhibition measure (basal inhibition, satiation, reactive inhibition) and extraversion. Furthermore, any correlation between reminiscence and extraversion was of such a low magnitude that it did not warrant further investigation.

Becker (2) cited evidence by Crutchfield, Woodworth and Albrecht (1958) who found that the amount of satiation effect produced in the kinesthetic figural after-effect apparatus correlated $r = .52$ with the tendency for satiation effects to dissipate over time (this was contrary to Eysenck's hypothesis (15) that extraverts should build up more satiation effects quickly and dissipate them more slowly). Becker

suggested two important answers for the confusion existing in this area. First, terminology may be confusing. Second, the assumption that satiation effects and reactive inhibition are the same construct may not be justified.

Norcross, Lipman, and Spitz (59) found results that failed to confirm Eysenck's hypothesis (15) that satiation effects in extraverts develop more quickly, reach higher levels, and dissipate more slowly than in introverts. They tested one hundred twenty-seven subjects separated into the two groups based on their personality scores. Investigation of the rate of development of visual satiation effects, total amount of visual satiation, total amount of kinesthetic satiation, rate of dissipation of kinesthetic satiation and rate of dissipation of visual satiation was carried out. Of twenty correlations analyzed only one was significant in the predicted direction of Eysenck's hypothesis (15). They added that this one correlation may have been due to chance. The correlation that was significant was $r = .29$ ($p < .05$) between extraversion score of females in Group I and their total amount of visual satiation. They concluded that the use of satiation measures obtained from different modalities could possibly account for the different results. They summarized several other studies in this area that failed to confirm Eysenck's hypothesis (15).

Claridge and Herrington (10) made a deduction with regard to Eysenck's theory (15) that was rather ambiguous. They stated that their findings supported previous work by Eysenck that sedation thresholds are higher in dysthymics. This statement appears contrary to Eysenck's position as described by him in several studies (15,16,53). Claridge

and Herrington (10) report a significant relationship between extraversion (hysterics) and sedation threshold, a statement contrary to the statement above that "sedation thresholds are higher in dysthymics (introverts)." However this significant correlation occurred only when the normal group was taken separately. They proceeded to suggest a link between arousal theory and Eysenck's inhibition theory of personality (15). They suggested that the difference between hysterics and dysthymics could be explained in terms of a shift due to changes in the state of arousal, in the excitation-inhibition balance underlying introversion-extraversion. From this deduction, they postulated that the sedation threshold is low in hysterics (extraverts) and high in anxiety states, or as he refers to them, dysthymics (introverts). Therefore, it follows from Eysenck's work (15), that sedation thresholds should correlate negatively with extraversion. This statement does not appear to be warranted. They (10) offered further evidence to support their prediction. Claridge in a study (in print) has confirmed their hypothesis and a modification to Eysenck's hypothesis (15) was suggested. The hypothesis proposed was that the excitation-inhibition balance and the level of arousal are linked in such a way that upward or downward changes in the latter will be reflected in a parallel shift in the excitation-inhibition balance. Thus, in hysterics a decrease in arousal level occurs, resulting, other things being equal, in a more rapid growth of inhibitory processes than would be predictable from the hysterics position on the introversion-extraversion continuum. A corresponding delay in the growth of inhibition would be expected from the heightened arousal level which occurs only in dysthymics. The evidence reported in the above section does disagree with Eysenck's prediction of inferior

performance for the extraverts on physical tasks. However the evidence in opposition to Eysenck's theory is not overwhelmingly clear due to the methodological differences in testing hypotheses (15,16,27).

Literature Pertaining to Extraverts as more Persistent than Introverts

Costello and Eysenck (11), in a study on seventy-two children between the ages of fourteen and seventeen years, conducted the following experiments. Eight groups of nine children were selected on the basis of the Junior Maudsley Personality Inventory. Each subject was given three trials of strength on a dynamometer, with twenty-second intervals between trials in the order of right-left-right; thirteen minutes later, three more trials were administered in the order of left-right-left. Two-thirds of the mean strength of each hand was calculated and each subject was given two trials of persistence at this setting. The subjects were instructed to keep a pointer at a certain specified level; the two trials correlated r = .80 and their mean was the subject's persistence score. Mean persistence scores for extraverts and introverts were 39.30 and 30.06, respectively. The results support the hypothesis that extraverts are more persistent than introverts. Extraverts, in this study, were approximately 30 per cent more persistent than introverts, results being significant at p = .02 level of probability. It should be noted that extraverts and introverts did not differ significantly in their pre-persistence strength records.

Howarth (42) reported findings that lend support to the Costello and Eysenck (11) conclusions. Howarth's (42) study examined a wide variety of experimental measures and their relationship to

introversion-extraversion. He administered the Maudsley Personality Inventory to three hundred nine first-year psychology students. Fifty-eight subjects were selected on the basis of their personality scores and tested on two pertinent persistence measures, namely, breath-holding and leg persistence. The results indicated that no significant differences between extraverts and introverts existed on the former task. However, introverts were significantly inferior to an intermediate group. Furthermore, on the leg persistence task the extraverts held up their legs significantly longer than the introverts. The mean score for extraverts was 76.2 seconds, an intermediate group scored 79.4 seconds and the introverts lasted only 59.7 seconds. All significant results were obtained at the five per cent level. Howarth concluded that differences in breath holding and leg persistence ability could feasibly be explained in terms of higher pain thresholds in extraverts.

From the above evidence extraverts would be expected to be more persistent on physical tasks that are painful to the subject.

THEORETICAL REASONS FOR EXTRAVERTS BEING MORE PERSISTENT THAN INTROVERTS[1]

Costello and Eysenck (11) reported that Eysenck (21) stated that, theoretically, persistence tests may be subdivided according to the negative drive which opposes continuation, that is, "pain" in the case of physical tasks (Rethlingshafer, 66, and MacArthur, 54),

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[1]In order to achieve maximum clarity it is necessary to subsection reasons or theories accounting for the findings presented.

"boredom" in the case of ideational tests, and according to the positive drive which motivates continuation, that is, "group prestige" or "self motivation" (MacArthur, 54). Furthermore, Eysenck (21) was reported to have said that it may be predicted from the general theory of Eysenck (17,20) that positive sources of motivation will apply more strongly to extraverts. It may similarly be predicted, according to Eysenck (21), that pain will be a stronger negative drive for introverts who would be expected to be less persistent on physical tasks, while boredom will be a stronger negative drive in extraverts, who would be expected to be less persistent on mental tasks. Considering these general statements in terms of learning theory involving such tasks as the pursuit rotor and inverted alphabet printing this would account for the findings that extraverts are consistently inferior. Also, on tasks involving persistence where learning was negligible extraverts have been found superior. This superior performance on the part of the extraverts could be accounted for on the basis of the above outlined sources of positive motivation or the higher pain tolerance of the extraverts. Since there is no reason to believe that different levels of drive exist between the two personality groups in question, the latter explanation would take precedence.

Feldman, (27), gives an excellent review of the literature in the area of persistence linking together optimal stimulation theory and inhibition theory. MacArthur (34) found a group of physical persistence tasks to have high loadings (factor analytical study) on a factor on which non-physical tasks had insignificant or zero loadings. The suggestion is that one group of tests is related to tolerance for an

increasing level of sensory input, and the other was related to the ability to emit responses continuously. Optimal stimulation approach predicts that increased drive will result in a poorer performance on the former; inhibition theory predicts that an increase in drive will improve performance on the latter. Dynamometer persistence is an example of a physical persistence task; persistence should, therefore, be decreased by an increase in drive. Unfortunately, there is an absolute dearth of studies concerning motivation and dynamometer persistence, so that the prediction must be made in the absence of previous empirical evidence. According to Feldman (29), Eysenck (17) has considered the dynamometer as a task on which predictions from his typological postulate of inhibitory potential may be made. Eysenck and Costello (11) found subjects high in extraversion to be more persistent (previously reported). This finding was contrary to earlier research and was not in line with either the optimal stimulation theory or inhibition theory. It does appear to agree with pain tolerance findings.

Literature Pertaining to Introverts as More Persistent than Extraverts

Eysenck (13) reported a study by Petrie who examined twenty-five male and twenty-five female dysthymics and twenty-five male and twenty-five female hysterics on a persistence task. The task required the subject to hold his heel one inch over the seat of a chair. The total time a subject was able to prevent his heel making contact with the chair was recorded. The results indicated that the two hysteric groups obtained average scores of 14.1 ($\pm$ 9.6) seconds and 13.9 ($\pm$9.2) seconds, while the two dysthymic groups obtained scores of 29.1 ($\pm$ 20.8)

and 32.5 (± 25.9) seconds, respectively. The dysthymics persevered over twice as long as the hysteric group. This difference was reported to be significant beyond the .01 level of probability. Petrie was reported to comment that this conclusion agrees well with the clinical impression as outlined by Kraeplin (1899). Kraeplin pointed out that hysterics usually attack a new task with greater energy but tire very soon, show no tendency to persevere, and regard everything as a game, without seriousness or persistence.

Hemphill, Hall and Crookes (39), in a fatigue study using forty-two female patients, outline some of the clinical aspects of pain and fatigue tolerance in depressive and psychoneurotic patients.[1] The subjects were required to pull up on a weight which was so attached that a kymograph recording could be obtained. The weight was two kilos and the pace was set by a metronone at seventy beats per minute. The distance of each pull was recorded. The mean difference between the depressives and the psychoneurotics was significant in favor of the depressives (+ = 2.180). Hemphill, Hall and Crookes (39) explained these findings in terms of sensitivity to fatigue. They stated that depressive patients show considerably less sensitivity to fatigue, and have a higher subjective threshold for fatigue perception, than do psychoneurotics. These findings disagree with findings of Lynn and Eysenck (53) and Howarth (42).

Eysenck (17) reported that extraverts can be expected to be inferior to introverts on persistence tasks (reasons are outlined in the following section).

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[1]For purposes of the present experiment depressive subjects can be considered to be introverted and psychoneurotic patients as extraverted.

THEORETICAL REASONS FOR INTROVERTS BEING MORE PERSISTENT THAN EXTRAVERTS[1]

Eysenck (17) reported that persistence was another trait found to discriminate between extraverts and introverts, a difference which can be derived from this theory. He stated that two factors may have accounted for this phenomena. In the first place, there is social pressure in the direction of persistent behavior at home, in school, and at work; this is part of the socialization process, and would consequently lead to greater persistence in introverts. However, persistence nearly always involves some degree of repetitive work, some long-term exposure to identical stimuli and would thus be predicted to lead to more rapid build-up of reactive inhibition. This line of argument would lead to the prediction that extraverts would be found lacking in persistence. Both arguments lead to a similar prediction and therefore may be considered to reinforce each other. This conclusion does not agree with the statement of Eysenck (21) with regard to the extraverts being more strongly affected by positive sources of motivation and pain versus a stronger negative drive for introverts. The confusion appears to result from accounting for performance differences in terms of different underlying mechanisms.

Feldman (29) gives a review of the literature in the area of persistence. As will be noticed, certain statements do not appear to be correct. However, a degree of clarity is achieved in the final sentences that justifies the total reiteration. The inconsistencies

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[1]In order that maximum clarity be achieved it was necessary to sub-section reasons or theory accounting for the findings presented.

are highlighted by the present author.

MacArthur (54), as reported by Feldman (29), found a group of physical persistence tasks to have high loadings (factor analytical study) on a factor on which nonphysical tasks had insignificant or zero loadings. The suggestion is that one group of tests is related to tolerance for an increasing level of sensory input, and the other is related to the ability to emit responses continuously. Inhibition theory predicts that an increase in drive will improve performance on the latter; an optimal stimulation approach predicts that increased drive will worsen performance on the former. Dynamometer persistence is an example of a physical persistence task; persistence should, therefore, be decreased by an increase in drive. However, there is a dearth of empirical evidence in this area. Eysenck (17) has considered the dynamometer as a task on which predictions from his typological postulate of inhibitory potential may be made. The present approach is that subjects who tolerate high levels of sensory input well should show poor tolerance for low levels. In terms of the introversion-extraversion dimension as measured by the Maudsley Personality Inventory (Eysenck 1959a), this implies better toleration for sensory deprivation situations by introverted than by extraverted subjects, and such a result has been reported by Petrie, Collins, and Solomon (63). Eysenck (26) considers that because reactive inhibition is held to subtract from drive, highly inhibited (extraverted) subjects are low in effective drive. This contention is later clarified when Eysenck (27) states that there is a lack of evidence to suggest different drive levels

between the two personality groups. Eysenck and Costello (11) found subjects high in extraversion to be more persistent; Feldman states that Eysenck's and Costello's finding is in line with optimal stimulation approach. Assuming that differences in drive level do exist as suggested here, this would be correct. However, this finding disagrees with expectations based on inhibition theory. Furthermore, as mentioned previously, there is no evidence indicating that the two groups differ in drive levels. Several other studies are relevant. It has been shown that pain tolerance is related to physical persistence (Thornton, 1940), so that correlations between pain tolerance and extraversion would be expected. The prediction has been tested and confirmed by Petrie (61) and Lynn and Eysenck (53). Neither S. B. G. Eysenck (1955) nor Himmelweit and Petrie (1951) (references are unpublished studies reported by Feldman), found correlations between extraversion and leg persistence. It is likely that both leg and dynamometer persistence involve maintaining a response as well as tolerating the continued reception of stimulation. For any given subject, inhibition due to response evocation may or may not be more aversive than high levels of stimulus input associated with these tasks. The consequence of both is that the subject will cease to persist. Should the situation be one in which inhibition build-up is more aversive than continued stimulation, introverts will show more persistence. For this reason predictions relating extraversion and persistence on tasks other than pain tolerance, which seems to involve sensory input only, are somewhat hazardous. Feldman (29), in an unpublished study, was unable to replicate the results of Eysenck and Costello (11).

Literature Pertaining to the Extent of Relationship Between Extraversion and Pain Tolerance

Petrie, Collins, and Solomon (62), in a study on pain tolerance and susceptibility to satiation, reported that pain tolerance was positively related to satiability (magnitude of the correlation not reported). Their results bear out the hypotheses examined that: pain tolerance was positively related to satiability and secondly, that sensory deprivation tolerance was negatively related to satiability. An inference was made that satiability may prove to be part of the mechanism of tolerance and intolerance and that pain tolerance is inversely related to sensory deprivation.

Furthermore, these authors report an unpublished study by Eysenck and Nichols wherein a relationship between personality and susceptibility to satiation was established. Eysenck and Nichols discovered that the more extraverted the personality the greater the susceptibility to satiation. The hypothesis which was thus suggested and to which the study under discussion brings some support was that the individual who tolerated pain best was also most susceptible to satiation. Satiation may indeed prove to be the mechanism of tolerance in that an intermittent "bigger wave"[1] of pain causes a subsequent pain to be perceived as less intense.

Petrie, et al. (63) mention that the effect of brain lesions is apparently selective; earlier work in England has shown that four

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[1]Direct quote from the author (74).

operations outside of the prefrontal region had no effect on sensitivity to pain, also, had no effect on satiability and other measures related to extraversion. Petrie, Collins, and Solomon (62) state that, after a prefrontal lobotomy a person is more like a psychopath and less like a depressive. Therefore, the post-operative patient would most closely resemble an extravert. Their findings supported the psychopath or extraverted personality as withstanding more pain, results being significant at the five per cent level.

Sigal, et al. (75) criticized Petrie, et al. (63) for using the Maudsley Personaltiy Inventory to distinguish the psychopaths, from the depressives. Moreover, their experiment was conducted under conditions of severe sensory deprivation.

Lynn and Eysenck (53) carried out an experiment using thirty volunteer subjects separated into three groups on the basis of the Maudsley Personality Inventory and a rotating spiral after-effect. The rotating spiral after-effect was previously reported by Eysenck (22) to be an effective measure of extraversion. Pain was induced by means of heat stimulation to the forehead using the technique described by Hardy, Wolff and Goodell (38). Intercorrelations between the personality traits and pain tolerance failed to reach significance at the one per cent level of significance. However, some confusion existed with regard to the correlation between extraversion and pain tolerance. The authors (53) reported a correlation of .69 ($p = .01$), but commented that it failed to reach significance. In the summary they stated that significant correlates were discovered between pain tolerance and extraversion. The initial statement appears to be incorrect because they go

on to say that the results support the deduction from Eysenck 's experiments (17,22) that pain tolerance is positively related to extraversion. Extraverted subjects are postulated (17,22) to develop inhibition/satiation more quickly, and dissipate it more slowly. Prolonged pain sensations should thus be inhibited more quickly and strongly in extraverts, leading to diminished pain sensations. Lynn and Eysenck (53) refer to an earlier study by Beecher (4), who found that physiological pain sensations are always accompanied by apprehension of future pain, which may be conceived as conditioned fear or anxiety response which summates with physiological pain. Beecher (4) was reported to state that extraverts are predicted to condition "less well,"[1] and would therefore not develop this component of total pain to the same extent as an introvert. This point is supported by a study of Franks (32) on an eye-blink (P.G.R. reflex) and personality. Franks (32) reported that extraverts condition "much less well"[2] than introverts.

Lynn and Eysenck (52), reviewing a portion of the literature in this area, report the following: they state that the very positive findings of their own study duplicate those of Petrie (61), Petrie, et al. (63), and Poser (1960).[3] The latter subjected eighteen female subjects to ischmic pain and found a correlation of r = .53 with extraversion, as measured by the Maudsley Personality Inventory; the former also used the Maudsley Personality Inventory and subjected

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[1]Direct quote from Beecher. [2]Direct quote from Franks.

[3]Study reviewed in Lynn and Eysenck.

fifty-five subjects to surgical or experimental pain. In this study, Petrie (61) reported significant differences (statistics not reported) between introverts and extraverts with regards to pain tolerance (she also verified a complementary prediction derived from the hypothesis that stimulus deprivation would be better tolerated by introverts). The extensive data of Hall and Stride (36) on some four hundred psychiatric patients may also be quoted in support of Petrie's (61) findings. They found least pain tolerance in dysthymics, that is, introverted neurotics. Furthermore, they reported an increase in pain tolerance following a prefrontal lobotomy which is an extraverting operation.

Petrie (61) explained the reason for the above-mentioned phenomena. She (16) reports that first, certain aspects of personality and perceptual style, which are changed by a prefrontal lobotomy carried out for the relief of pain, are precisely those that differentiate, within the normal population, those who can tolerate pain well from those who suffer greatly from pain; second, these differences in tolerance for pain are paralleled by other striking differences in the subjectively perceived intensity of sensation other than pain. Some persons, whose nature it is to reduce the intensity of their perceptions subjectively, can tolerate pain well; third, there appears to be sex differences in this tendency to reduce the subjectively perceived intensity of sensation.[1]

It appears from the evidence presented that extraverts are more tolerant of pain. Research in this area provides unanimous support for this conclusion.

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[1]For a more exhaustive explanation of pain tolerance and its relationship to personality, see Petrie (73).

CHAPTER III

METHODS AND PROCEDURES

Selection of Subjects

The Maudsley Personality Inventory was administered to the total first-year male population of the University of Alberta. From this population a sample of seventy-two healthy subjects between the ages of eighteen and twenty-one were selected. Their selection was based on the extreme introvert and extravert scores. These subjects were subjected to various physical tasks designed to measure work decrement, reminiscence and physical persistence.

Experimental Design

Preamble. A pilot study was conducted to determine the tasks necessary for the experiment. Three separate testing periods were used in the experiment. On the first day the Maudsley Personality Inventory was administered to the total first-year male population. On the second day the subjects were tested on the pursuit rotor, arm persistence task and leg persistence task. On the last day the subjects were tested on the arm ergometer and the step test. These tests are described in a later section.

All subjects were required to be in attendance in the laboratory on day two and three in standard gymnasium attire. Upon arrival at the testing station instructions regarding test procedure were given by the experimenter. Each procedure was carefully explained just prior to

test commencement. All instructions were standardized. Daily records were made by the experimenter on data paper designed especially for the present experiment.

EXPERIMENTAL DESIGN

DAY ONE	SUBJECTS	DAY TWO	DAY THREE
The Maudsley Personality Inventory was administered to the total freshman population of the University of Alberta. Seventy-two subjects were selected. Thirty-six subjects were extreme introverts and thirty-six were extreme extraverts.	Introverts N = 36	Task One Pursuit Rotor Task Two Arm Persistence Task Three Leg Persistence	Task Four Arm Ergometer Task Five Step Test
	Extraverts N = 36	Task One Pursuit Rotor Task Two Arm Persistence Task Three Leg Persistence	Task Four Arm Ergometer Task Five Step Test

Procedure

Task one-pursuit rotor. The subjects were required to work on the pursuit rotor at the rate of sixty revolutions per minute. Work

lasted continuously for five minutes, followed by a ten-minute rest, followed by a five-minute continuous work period. During the rest period the subject was given a magazine and instructed to sit down and read. The time spent on target per twenty-second interval was recorded from a standard electric chronoscope, except for the last thirty seconds of pre-rest and the first thirty seconds post-rest practice. During these two periods, the time spent on target was recorded each ten-second interval. This procedure was necessary in order to obtain an optimal reminiscence measure.

Task two-arm persistence. The subject was instructed to stand next to the apparatus so that his right arm was fully extended and at shoulder height when the microswitch was open. The subject was told to concentrate on holding his arm at shoulder height so the microswitch would not close. Total time in seconds was recorded from a chronoscope when the subject could no longer keep the microswitch open.

Task three-leg persistence. The subject was instructed to sit on a chair in front of the apparatus so that his right leg was fully extended and at a horizontal position when the microswitch was open. The subject was told to concentrate on holding his leg so the microswitch was maintained open. Total time in seconds was recorded from a chronoscope when the subject could no longer keep the microswitch open.

Task four-arm ergometer. The subject was required to work on an arm ergometer at his fastest possible rate and to try to maintain his

Plate 1: Pursuit Rotor (Task one)

Plate 2: Arm Persistence Apparatus
(Task two)

fastest possible rate for as long as he could. The actual length of the test period was predetermined. All subjects were unaware of the length of time they were required to work. The test period consisted of a ten-minute continuous work period, followed by a ten-minute rest period, followed by a five-minute post-rest work period. Recordings were the same as for task one.

Task five-step test. The subject was required to follow the same procedure for task four, only using a step test rather than an arm ergometer. Recordings were taken from an electric counter at the same intervals as tasks one and four.

During all tasks the subjects received no motivation from the experimenter other than from the initial pre-work instructions.

Apparatus

Pursuit rotor. The pursuit rotor (P.R.) was a turntable, ten inches in diameter, which rotated in a clockwise direction at sixty revolutions per minute. The target was 7/10 inches in diameter, set with its center three and one-quarter inches from the center of the turntable, and flush with its surface. An articulated stylus weighing two ounces, having a circular plastic handle four and one-half inches long, was used. The rod extension was six inches long, one-tenth inch in diameter with a ninety degree bend one inch from the tip, hinged so that only its weight rested on the turntable. Steady contact between the target and the stylus closed a circuit and a recording was made on a chronoscope.

Plate 3: Leg Persistence Apparatus (Task three)

Plate 4: Arm Ergometer (Task four)

Plate 5: Step Test (Task five)

Arm persistence apparatus. The arm persistence apparatus consisted of a back plate of wood on which a hinged board was mounted. The board was attached in such a manner that it could be lifted to contact a microswitch. When the board was horizontal the microswitch was open. When the board was lowered one-half inch the microswitch was closed. Closing of the microswitch stopped a chronoscope from which a total time in seconds was available. At the end of the hinged board was a strap which the subjects were required to have fastened to their hand. A peg below the microswitch prevented the hinged board from swinging loosely. The total apparatus was adjustable in height.

Leg persistence apparatus. The leg persistence apparatus consisted of a metal plate that was attached to a horizontal bar. From the metal plate two pegs extended downward in a vertical manner. One peg was adjustable to ankle width. When the subject lifted his leg to an extended position a treadle opened a microswitch that was attached to a chronoscope. When the subject allowed his leg to lower one-half inch the microswitch closed and total time in seconds was available on the chronoscope.

Arm ergometer. The arm ergometer required a continuous circular arm movement in a horizontal plane. The subjects rotated continuously a crank attached to a controllable friction device. The subjects grasped a vertical crank four inches in length with the palm of their hand. The lever was affixed to an axle which carried a pully beneath it. The pulley resisted turning because of friction against a cord

which passed over it. The cord included an extensible spring which formed an endless loop from the friction pulley to an idler pulley. The distance from the idler pulley to the friction pulley was adjustable, so that greater tension could be placed on the crank. As the crank was turned, the closed loop tended to rotate but was resisted by a spring balance anchored to the base of the ergometer. The amount of force required to turn the crank at a particular setting of the ergometer was indicated by the deflection of the spring balance during rotation. When the crank was at rest the spring balance read zero.

The ergometer was rigidly attached to a table fastened to a laboratory table. To help the subject maintain a constant position, he extended his left arm and held on to a second (fixed) handle placed twelve inches to the left of the crank axle. A fibre panel covered the entire apparatus except for the fixed handle and the crank. An electric counter was attached to the frictional pulley.

Step test. The step test was a steel platform eighteen inches in height. There was a cross bar that was adjustable to the subject's shoulder height. The cross bar was used to help the subject pull himself to an upright position on top of the platform. At the base of the platform was an electrified rubber mat that was attached to an electric counter. When the subject touched the mat a score was counted.

Chronoscope. A standard model S-1 Precision timer with AC. 120 volt clutch was used.

Statistical Procedures

Two statistics were used to analyze the data. First, one-way analysis of variance was used to test the significance of differences between the means of the two groups (refer to Tables 2, 4, and 6) under results. Second, Pearson's correlational coefficient was used to describe the relationship between selected measurements within each of the traits (refer to Tables 3, 5 and 7).

In order to justify the use of the above-mentioned statistics the variables involving should meet the following standards.

The F Ratio

1. Interval scale of measurement. The variables within the present experiment are considered to be on an interval scale of measurement. This was hard to defend on a rigorous basis.

2. Homogeneity of variance. There was no a priori reason to believe that the variables would have heterogeneity of variance. It was previously decided that if inspection of the variances warranted a test for homogeneity, Hartley's F_{max} test would be appropriate. However, in the context of the present experimental design involving only two groups an F test achieves the same result as an F_{max} would. Furthermore, there is considerable evidence to indicate that in the common case in experimental work where the number of observations is the same for the various treatments, the F test for the means in the analysis of variance is little influenced by heterogeneity of variance (7). Box (7) emphasizes that since the F test is very insensitive to nonnormality and since with

equal n's it is also insensitive to variance inequalities, it would be best to accept the fact that it can be used safely under most conditions. In other words, the F test of the analysis of variance remains a robust test under a variety of violations of the assumptions on which it is mathematically based. To quote from Box (7), "To make the preliminary test on variances is rather like putting to sea in a rowing boat to find out whether conditions are sufficiently calm for an ocean liner to leave port."

3. Normality of distribution. Although there is no reason to believe that the variables are not normally distributed within the population according to Box (7) this would not affect the findings seriously.

4. Additive factor. A further assumption is that the effects of various factors on the total variation are additive (30). There is no reason to believe that this assumption is violated.

5. Random assignment. This assumption appears to be violated by the method of subject selection. However, the two groups are considered random samples of the populations of extreme introverts and extreme extraverts, therefore this assumption was met.

Pearson's Correlational Coefficient

The use of this statistic involves meeting the following assumption, as well as the assumptions met under sections one, two, three and five of the F-ratio.

1. Linearity of regression. For the present experiment non-linearity was not expected. McNemar (15) outlines a test for curvilinearity that could be applied if required.

Statistical Hypothesis

U_1 represented the extravert group of subjects

U_2 represented the introvert group of subjects

It was predicted for the present experiment that:

1. extraverts would demonstrate significantly more work decrement, faster rate of work decrement[1] and a greater amount of recovery (reminiscence) than introverts. The statistical hypothesis therefore being:

$$H_1 : u_1 > u_2$$

2. Introverts would demonstrate significantly more persistence than extraverts. The statistical hypothesis therefore being:

$$H_2 : u_2 > u_1$$

Computational Procedures

The computational procedure for testing the significance of differences of means using one-way analysis of variance was accomplished by the method of multiple linear regression as outlined by Hunka.[2] The

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[1]The author, upon investigating the work decrement curves, decided against the statistical analysis of this measure. The similarity in slopes of the two groups coupled with the interpretation problems of "fitted" curves precipitated this conclusion.

[2]This procedure has been documented by Bottenberg and Ward in the technical report PRL-POR-63-6 entitled, "Applied Multiple Regression," from 657th Personnel Research Laboratory, Aerospace Medical Division, Lackland Air Force Base, Texas. Essentially this procedures is for designing your own programs to be tested by a computor. For a detailed discussion of methodology see Hunka (45).

correlational coefficients were obtained simultaneously.

A variance interpretation of significant correlation coefficients was calculated. This was accomplished by squaring the r. The r^2 produces a statistic that gives the proportion of the variance of one variable that is predictable from or associated with the variance of the member to which it was correlated.

CHAPTER IV

RESULTS AND DISCUSSION

Results

Validity. No attempt to establish validity was undertaken as part of this experiment. It was assumed that the tasks involved provided valid measures of the criterion discussed. For information regarding the validity of the Maudsley Personality Inventory, refer to the Manual of the Maudsley Personality Inventory by Eysenck.[1]

Reliability. No attempt at establishing reliability was made using the subjects of the present experiment. A pilot study was conducted that yielded the following results (Table I) on a test-retest basis with forty-eight hours separating the two testing sessions.

TABLE I

RELIABILITY OF PERSISTENCE TASKS AS DETERMINED BY A PILOT STUDY

Task	N	r	Time Inverval
Right arm	10	.89	One trial
Right leg	10	.95	One trial
Arm ergometer	14	.88	10 mins. pre-rest
		.82	5 mins. post-rest
Step test	15	.91	10 mins. pre-rest
		.88	5 mins. post-rest

[1]The Manual of the Maudsley can be obtained on request from the Clark Irwin Book Company, Toronto, Ontario.

For the Maudsley Personality Inventory both split-half and Kuder-Richardson reliability coefficients have been calculated on many samples. For the extraversion scale, they lie between .75 and .85, with the majority above .80. Retest reliability was available only on about 100 cases and was .81 (6).

Subjects

The mean score, on the extraversion scale, of the 736 freshman subjects that successfully completed the questionnaire was 26.90 ± 9.29 units. These figures were comparable to those obtained on fifteen hundred normal American students whose mean was 28.52 ± 8.28 units (6).

Comparison of the Work Decrement[1] Measures Between Introverts and Extraverts

Results.[2] The mean work decrement scores on the arm ergometer for the introverts and extraverts were 82.47 ± 15.23 revolutions and 92.81 ± 21.46 revolutions, respectively. The difference between the work decrement scores for the two groups was significant ($F = 5.40$, $p = 0.02$).

The mean work decrement scores on the step test for the introverts and extraverts were 14.50 ± 16.76 step-ups and 15.50 ± 9.27 step-ups, respectively. This difference was not statistically significant ($F = 0.10$, $p = 0.76$). Table 2 summarizes both these results.

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[1]Refer to Figures 2(A,B), and 3(A,B) in a later section.

[2]All results were accepted as significant at the five per cent probability level.

The correlations between the work decrement scores with both groups were insignificant. Table 3 contains these correlations.

TABLE 2

COMPARISON OF WORK DECREMENT SCORES FOR INTROVERTS AND EXTRAVERTS

	Introvert			Extravert				
Task	Mean	SD	Units	Mean	SD	Units	F	p
Arm ergo-meter	82.47	15.23	revs.	92.81	21.46	revs.	5.40	0.02
Step test	14.50	16.76	steps	15.50	9.27	steps	0.10	0.76

TABLE 3

CORRELATIONS BETWEEN WORK DECREMENT MEASURES FOR INTROVERTS AND EXTRAVERTS

Correlated Task	Introverts	Extraverts
Arm Ergometer-Step Test	0.14	0.10

Discussion. The greater amount of work decrement for the extraverts as hypothesized was substantiated. The extraverts demonstrated significantly, as hypothesized, more work decrement on the arm ergometer task than did the introverts. Eysenck (27) predicted that extraverts would perform at an inferior level to introverts, because extraverts have more involuntary rest pauses during work. The present findings should not be misinterpreted to support Eysenck's prediction (27). Although extraverts demonstrated greater work decrement than

introverts, it did not result in an inferior performance for the extraverts. On the contrary, the extraverts began at a higher level and declined more, because they completed more revolutions than the introverts. This resulted in a larger work decrement score for the extraverts while still maintaining a superior performance. This finding supported the results of Ray (65) who reported that introverts performed at an inferior level on a continuous work task though in actuality Ray's (65) findings failed to reach significance.

The mean work decrement scores on the step test were greater for the extraverts than for the introverts. The difference was not statistically significant. Although the extraverts demonstrated a greater amount of work decrement, they still maintained a superior level of performance. The predicted greater amount of work decrement for extraverts was not confirmed. Eysenck's prediction (27) that introverts should perform at a superior level to extraverts was not supported. The findings of the present experiment, with regard to level of performance, agree with those of Ray (65), as reported in the above section.

The correlations between the work decrement measures were non-significant.

Comparison of the Reminiscence Measures Between Introverts and Extraverts

Results. The difference between all the reminiscence measures[1] for each of the tasks failed to reach significance.

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[1]Refer to Figure 1 in a later section.

On the pursuit rotor the mean reminiscence scores for the introverts and extraverts were 4.84 ± 2.70 seconds and 5.11 ± 2.52 seconds, respectively ($F = 0.19$, $p = 0.67$).

On the arm ergometer the mean reminiscence scores for the introverts and extraverts were 49.72 ± 15.98 revolutions and 51.78 ± 17.06 revolutions, respectively ($F = 0.27$, $p = 0.61$).

On the step test the mean reminiscence scores for the introverts and extraverts were 8.28 ± 15.79 step ups and 9.89 ± 4.33 step ups, respectively ($F = 0.34$, $p = 0.56$).

The correlation between pursuit rotor reminiscence and arm ergometer reminiscence was $r = -0.46$, which reached significance. The variance common to both tasks was therefore 21 per cent. The remaining correlations failed to reach significance.

The above findings have been summarized in Tables 4 and 5.

TABLE 4

COMPARISON OF REMINISCENCE SCORES FOR INTROVERTS AND EXTRAVERTS

	Introverts			Extraverts				
Task	Mean	SD	Units	Mean	SD	Units	F	p
Pursuit Rotor[a]	4.84	2.70	Secs.	5.11	2.52	Secs.	0.19	0.67
Arm Ergometer	49.72	15.98	Revs.	51.78	17.06	Revs.	0.27	0.61
Step test	8.28	15.79	Steps	9.89	4.33	Steps	0.34	0.56

[a]Using the recommended optimal conditions for testing, the difference in reminiscence scores produced smaller differences between the two groups.

TABLE 5

CORRELATION BETWEEN REMINISCENCE MEASURES FOR INTROVERTS AND EXTRAVERTS

Correlated Tasks	Extraverts	Introverts
Pursuit Rotor-Arm Ergometer	-0.46[a](21%)[b]	0.02
Pursuit Rotor-Step Test	0.25	-0.11
Arm Ergometer-Step Test	0.05	0.13

[a]This correlation was statistically significant.

[b]Twenty-one per cent of the variance was common to both tasks.

Discussion. The differences in the reminiscence for the two groups failed to be significant for any of the tasks. In all instances the extraverts demonstrated greater reminiscence scores. However, the chance occurrence of such a phenomena rules out the possibility of making any conclusive statements about the importance of this measurement.

Eysenck (27) presented a detailed review of literature where evidence was reported that extraverts demonstrate greater reminiscence scores than introverts. Reminiscence was interpreted to be a measure of the amount of reactive inhibition build-up within the subjects. Reactive inhibition, he argued, should be determined by a reminiscence measure taken under optimal conditions (27). In the present experiment a variety of ways of calculating the reminiscence scores for the pursuit rotor was performed. Eysenck's recommended optimal method of calculation of reminiscence did not produce the greatest differences in the

reminiscence scores. Apparently, little importance can be attached to reminiscence scores as determinants of the amount of inhibition build-up. Although the findings did not refute Eysenck's predictions, they were of such a chance nature that no conclusion can be made from them. Even though the results did not add conclusive evidence to Eysenck's theory (27) they were in opposition to findings by Ray (65) and Becker (2), who have reported results contrary to Eysenck's predictions (27).

The reminiscence measures on the arm ergometer and step test were greater for extraverts, although not significantly so. It was interesting to note that the extraverts started out at a higher level, in the post-rest work period, than did the introverts.

At present it is very difficult to speculate if there is any future in investigating these constructs using physical tasks. However, further investigation, if carried out, should involve only one type of stimulus-response.

The correlations between the reminiscence measures again demonstrated task specificity. A correlation of -0.46 between pursuit rotor reminiscence and arm ergometer reminiscence was statistically significant, for the extravert group. The introverts failed to provide a similar result. Interpretation of this correlation coefficient would be of little value.

Comparison of the Persistence Measures Between Introverts and Extraverts

Results. The mean arm persistence scores of the introverts and extraverts were 275.78 $\pm$ 93.95 seconds and 242.89 $\pm$ 70.04 seconds

respectively. The mean results failed to significantly differentiate between the two groups ($F = 2.76$, $p = 0.10$).

The mean leg persistence scores of the introverts and extraverts were 122.28 $\pm$ 64.91 seconds and 115.75 $\pm$ 61.49 seconds, respectively. No significant difference between the two groups was found ($F = 0.19$, $p = 0.67$).

The mean persistence scores on the arm ergometer for the introverts and extraverts were 875.11 $\pm$ 179.28 revolutions and 951.31 $\pm$ 178.13 revolutions, respectively. The difference between means was statistically insignificant ($F = 3.22$, $p = 0.08$).

The mean persistence scores on the step test for the introverts and extraverts were 255.38 $\pm$ 39.07 step ups and 280.72 $\pm$ 38.01 step ups, respectively. The difference was significant at the required probability level ($F = 7.44$, $p = 0.01$).

Three significant correlations were found. Correlations between arm and leg persistence within the introvert group and step test persistence and arm ergometer persistence, within the introvert and extravert group, were $r = 0.29$, $r = 0.44$, and $r = 0.39$, respectively. The first correlation accounted for eight per cent of the common variance between arm and leg persistence. The remaining correlations accounted for nineteen and fifteen per cent of the variance between the step test and arm ergometer persistence scores, respectively.

Tables 6 and 7 summarize these findings.

Discussion. On both arm and leg persistence tasks no significant differences were found. However, on both tasks the results approached

TABLE 6

COMPARISON OF PERSISTENCE SCORES FOR INTROVERTS AND EXTRAVERTS

Task	Introverts Mean	S.D.	Units	Extraverts Mean	S.D.	Units	F	p
Arm	275.78	93.95	Secs.	242.89	70.04	Secs.	2.76	0.10
Leg	122.28	64.91	"	115.75	61.49	"	0.19	0.67
Arm Ergo.	875.11	179.28	Revs.	951.81	178.13	Revs.	3.22	0.08
Step Test	255.38	39.07	Steps	280.72	38.01	Steps	7.44	0.01

TABLE 7

CORRELATIONS BETWEEN PERSISTENCE MEASURES FOR INTROVERTS AND EXTRAVERTS

Correlated Tasks	Extraverts		Introverts	
Arm-Leg	0.19		0.29[a]	8%[b]
Arm-Arm Ergometer	0.16		0.19	
Arm-Step Test	0.25		0.16	
Leg-Arm Ergometer	-0.17		0.25	
Leg-Step Test	0.01		0.20	
Arm Ergometer-Step Test	0.44	19%[a]	0.39	15%[b]

[a]Indicates that the correlation coefficients were significant.

[b]Indicates the amount of variance common to both tasks.

an acceptable level of significance. It was interesting to note that the means of the introverts were superior to the extraverts on both tasks. Had a significant difference been found, it would have refuted the findings of Costello and Eysenck (11) and Howarth (42), who found extraverts superior on similar tasks. Also, studies dealing with pain tolerance and introversion-extraversion demonstrated extraverts as superior on physical tasks which were painful. Beecher (4), Lynn and Eysenck (53), and Petrie (61), Petrie, Collins and Solomon (62) and Petrie, et al. (63) have provided unanimous evidence that extraverts are more tolerant of pain.

Eysenck (13), Eysenck (17), and Hemphill, Hall and Crookes (39) reported findings supporting the present conclusion, that introverts are superior on physical tasks.

Feldman (29) gave some theoretical reasons that may have accounted for the inconsistencies in the findings. He stated,

> . . .It is likely that both leg and dynamometer persistence involves maintaining a response as well as tolerating the continued reception of stimulation. For any given subject inhibition due to response evocation may or may not be more aversive than high levels of stimulus input associated with these tasks. The consequence of both is that the subject will cease to persist. Should the situation be one in which inhibition accural is more aversive than continued stimulation introverts will show more persistence. Should the situation be one in which continued stimulation is more aversive than inhibition accural, extraverts would be more persistent.

Therefore, it appeared that the arm and leg persistence task were examples of a task where inhibition accural was more aversive than continued stimulation.

The fact that studies in the past have involved many different

types of stimuli and responses makes conclusions at this time premature. As Feldman (29) mentioned, it is hazardous at present to make predictions relating introversion-extraversion to persistence on tasks other than pain tolerance. Although the results were in line with the predicted outcome of the study they may have been due to chance.

The mean persistence scores on the arm ergometer failed to be significantly different for the two groups. However, the mean persistence scores for the two groups on the step test were significantly different. But, both results favored the extravert as being superior. Therefore, the hypothesized greater persistence of introverts was not upheld.

It was interesting to note that both the arm ergometer and step test involved a different response than the arm and leg persistence tasks. The latter were static and the former were dynamic in nature. This may be interpreted as supporting Feldman's theory (29). If the arm and leg persistence task involved a situation where inhibition accural was more aversive than continued stimulation the introverts would be superior (this was supported, although not convincingly so); conversely, if the arm ergometer and step test involved a situation where continued stimulation was more aversive than inhibition accural, extraverts would be more persistent. This latter statement was upheld on the step test and the arm ergometer tasks. The findings, however, failed to be significant.

Pain tolerance may have accounted for the superior performance of the extraverts on the arm ergometer and step test; as mentioned

previously, extraverts have been found to be more tolerant of pain (4,53,61,62,63).

Pain perception and different stimuli and responses have confused present and past findings. A need for further investigation, using the same personality dimension and tasks which involve only one stimulus and one response, is suggested.

The correlations between the various tasks support the principle of specificity of physical performance tasks.

A Comparison of the Rate of Work Decrement Between Introverts and Extraverts

Results. No statistical analysis of "rate" of work decrement was attempted. Figures 1, 2 (A,B), and 3 (A,B) graphically illustrate the level at which each group of subjects worked on the various tasks.

On the pursuit rotor the introverts maintained a superior position through almost the entire work periods.

On the arm ergometer both groups declined almost exactly at the same rate. The introverts tended to perform at an inferior level.

On the step test both groups declined at a similar rate. The introverts were inferior throughout both work periods.

Discussion. Although a statistical analysis of the rate of work decrement was not carried out, the plotted scores on the various tasks warrant mention with regard to the expected out come of the study.

Results demonstrated (Figure 1) that the extraverts performed at an inferior level during both work periods. Although the rate of dropoff

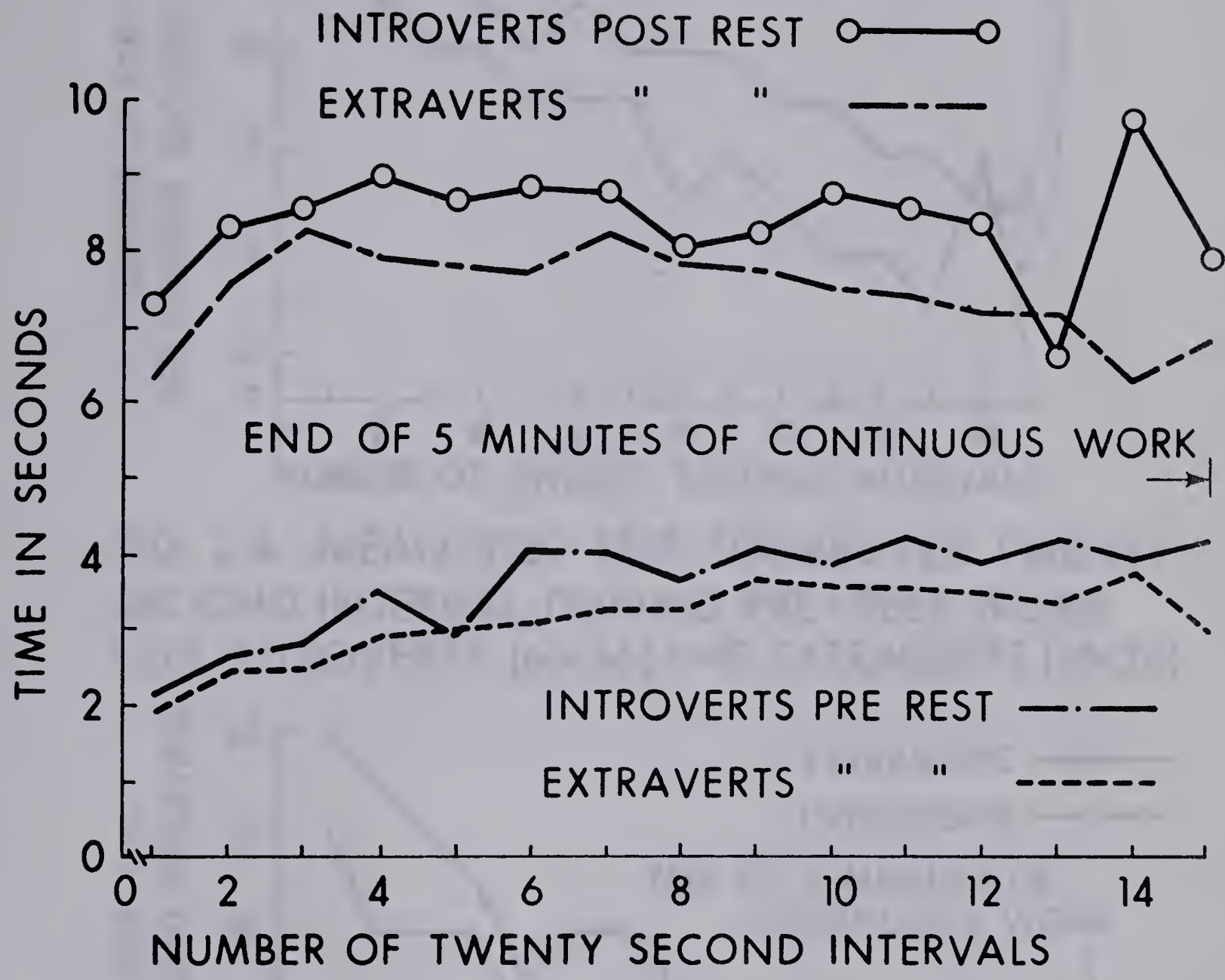
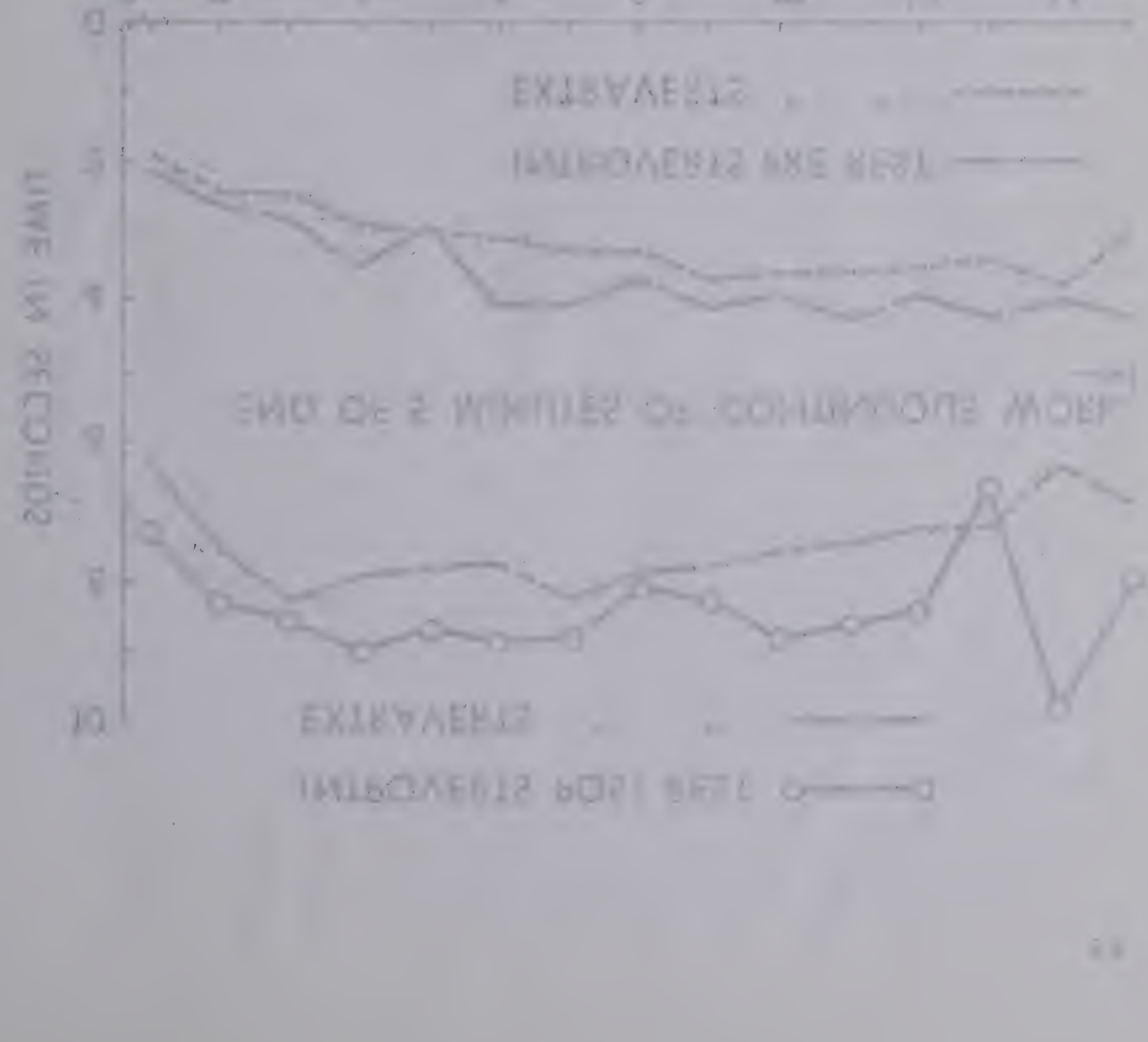


FIG 1 MEAN PURSUIT ROTOR SCORES PER TWENTY SECOND INTERVAL DURING PRE- AND POST- REST WORK FOR INTROVERTS (N=36) AND EXTRAVERTS (N=36)



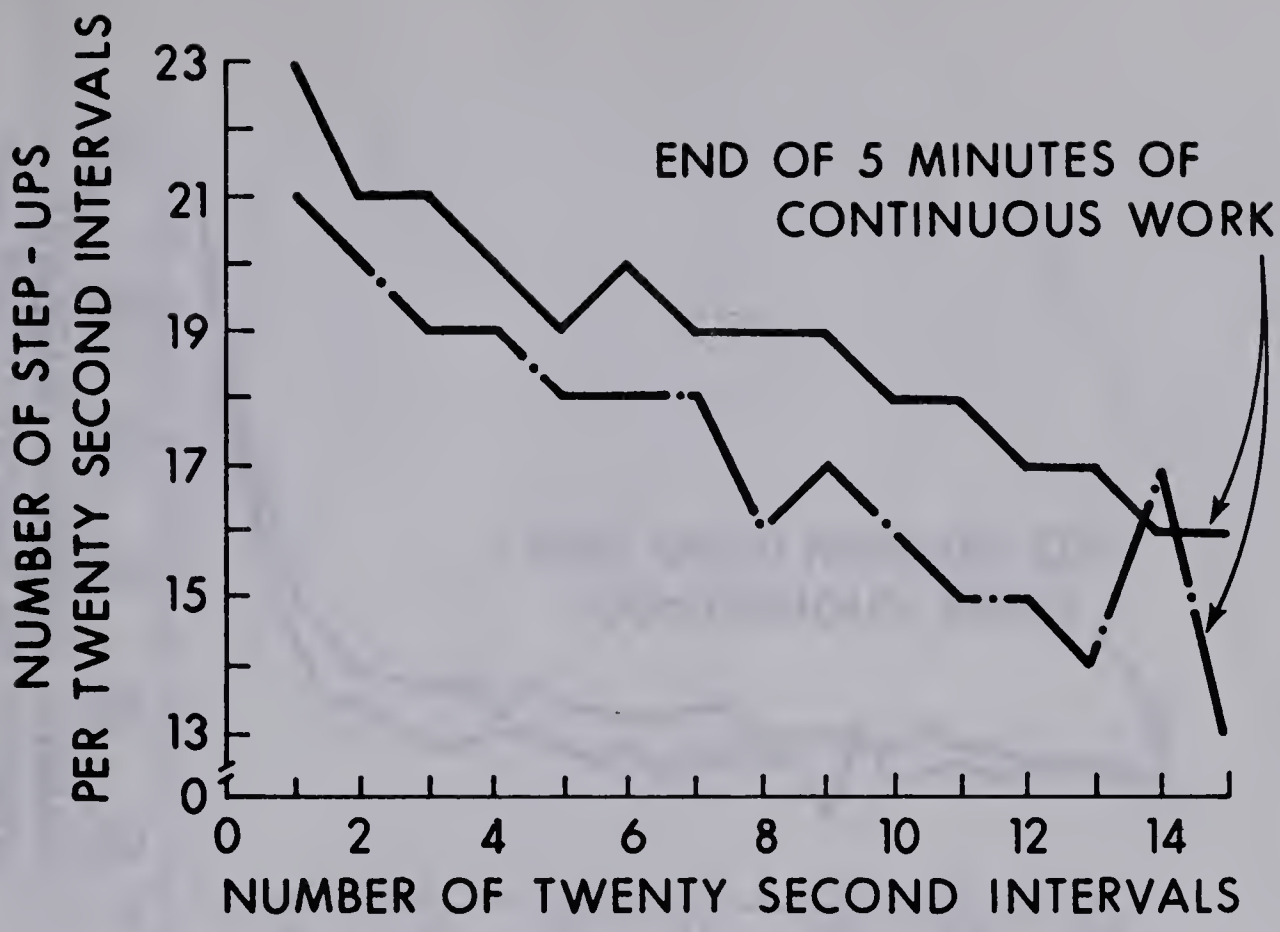


FIG 2A MEAN STEP TEST SCORES PER TWENTY SECOND INTERVAL DURING PRE-REST WORK FOR INTROVERTS (N=36) AND EXTRAVERTS (N=36)

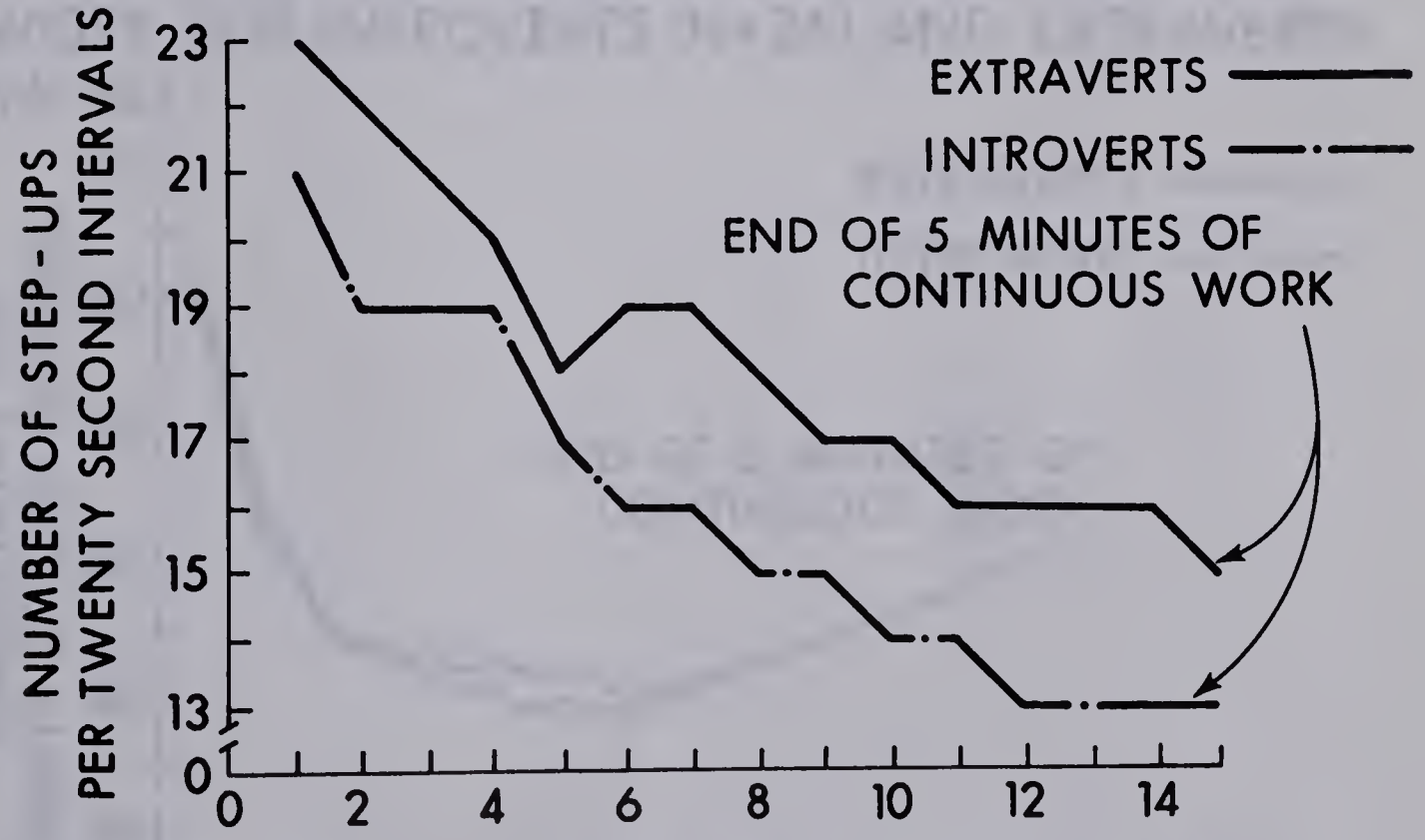
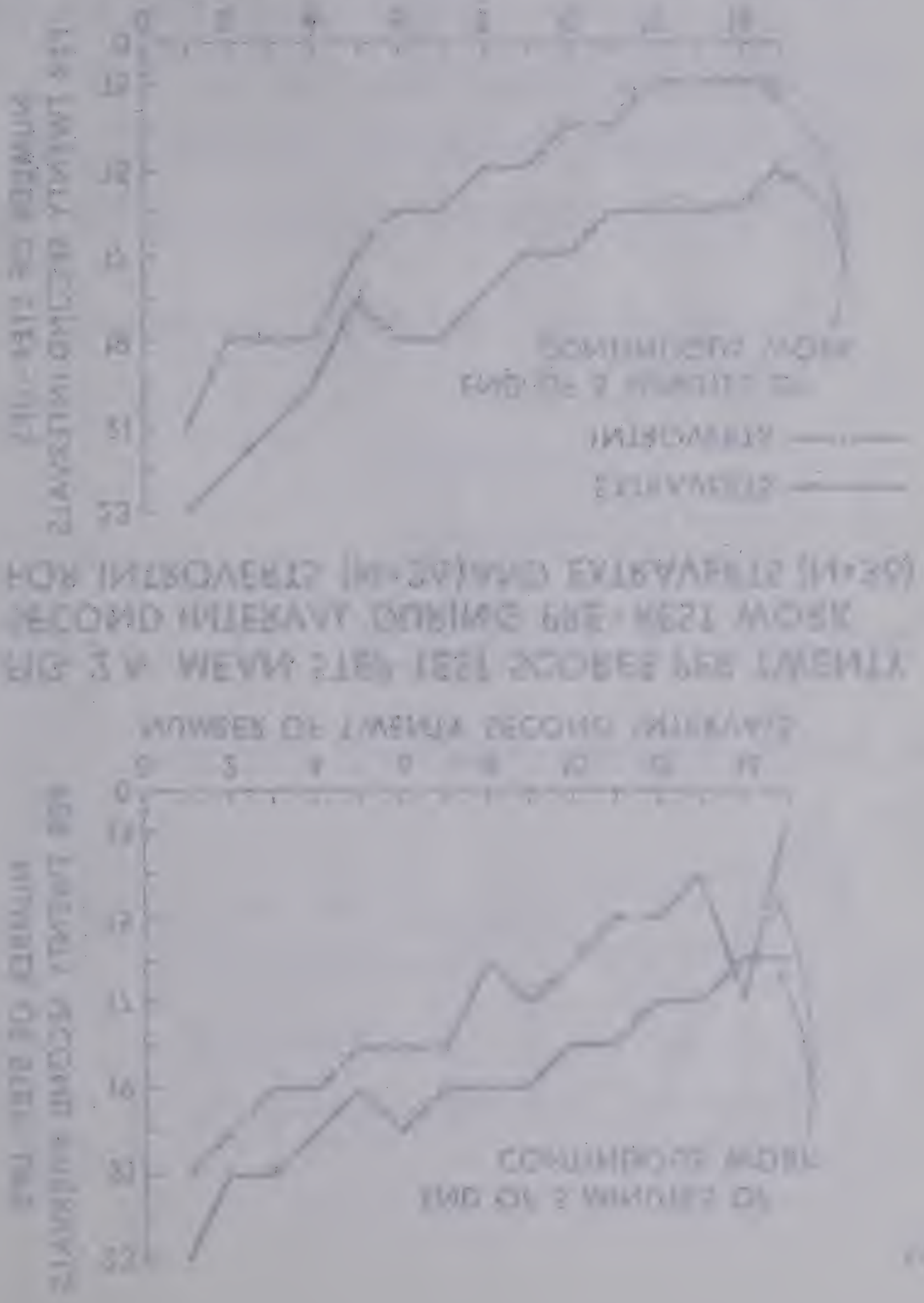


FIG 2B MEAN STEP TEST SCORES PER TWENTY SECOND INTERVAL DURING POST-REST WORK FOR INTROVERTS (N=36) AND EXTRAVERTS (N=36)



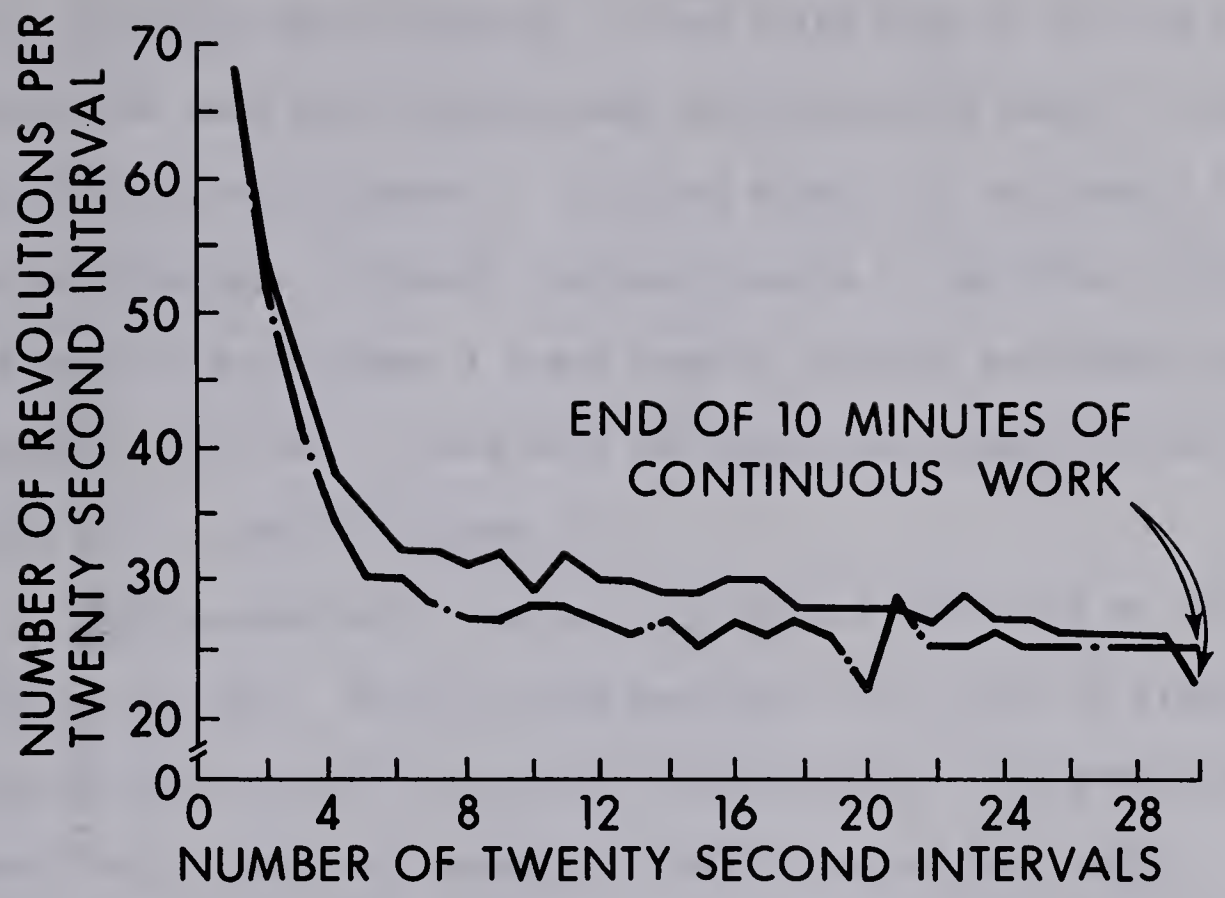


FIG 3A MEAN ARM ERGOMETER SCORES PER TWENTY SECOND INTERVAL DURING PRE-REST WORK FOR INTROVERTS (N=36) AND EXTRAVERTS (N=36).

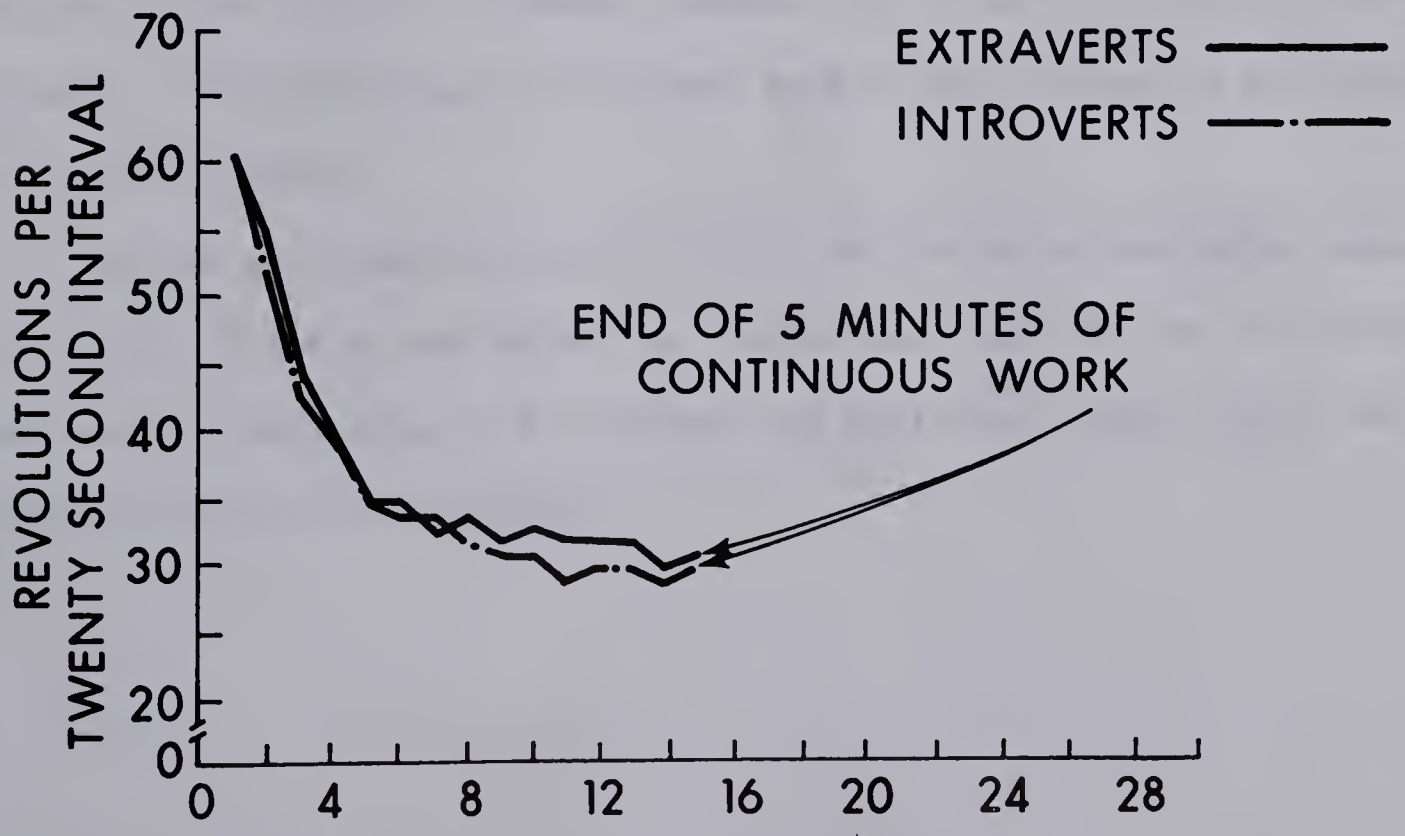
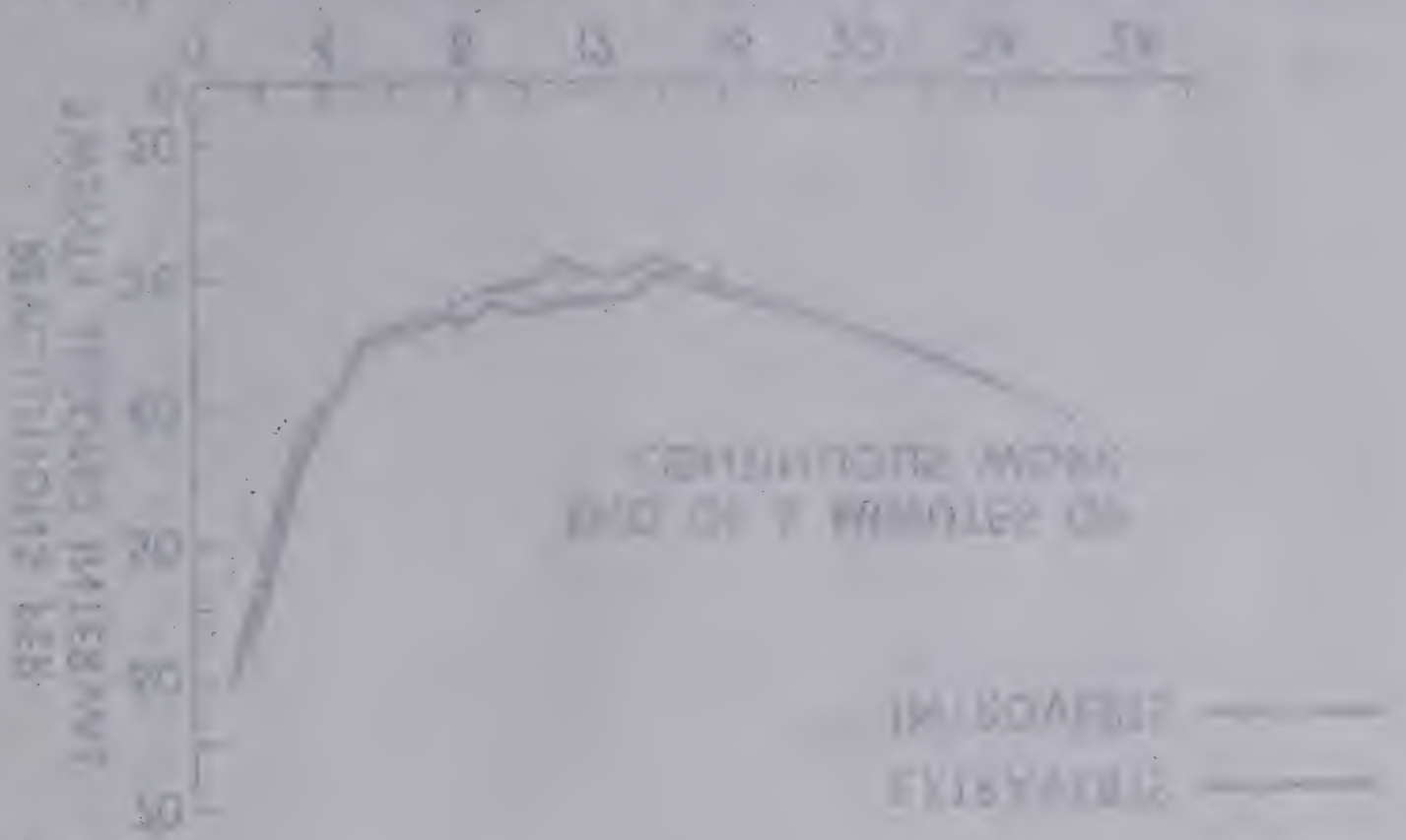


FIG 3B MEAN ARM ERGOMETER SCORES PER TWENTY SECOND INTERVAL DURING POST-REST WORK FOR INTROVERTS (N=36) AND EXTRAVERTS (N=36).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was not statistically examined, it was noted that as the end of the five-minute work period approached, the extraverts began to decline more rapidly than the introverts. This was especially noticeable in the post-work period. Although the significance of the rate of work decrement was not established a trend towards inferior performance was observed. This was in line with the predictions made for the study and agreed with Eysenck's theory (27).

Both groups had a similar rate of work decrement on the step test (Figures 2A, 2B). This may have been due to the type of stimulus-response (29) or pain tolerance (1,53,61,62,63). The prediction of a slower rate of work decrement for introverts was not upheld.

On the arm ergometer both groups demonstrated a very similar rate of work decrement (Figure 3A, 3B). The introverts performed at a slightly inferior level throughout both work periods. This may have been due to the type of stimulus-response (29) or pain tolerance (4,53, 61,62,63). The prediction of a slower rate of work decrement for introverts was not upheld.

On the arm ergometer and step test the subjects complained about the painful nature of the work. No records were made of the subjective responses to these tasks and therefore the difference found cannot be accounted for by this construct.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate the relationship of introversion-extraversion to the amount of work decrement, the amount of recovery, the amount of persistence and the rate of work decrement manifested in motor performance.

The subjects were seventy-two freshman males of the University of Alberta. They ranged in age from eighteen to twenty-one years old. They were chosen on the basis of their scores on the Maudsley Personality Inventory.

The subjects performed certain physical tasks (pursuit rotor, arm and leg persistence, arm ergometer and step test) which were designed to obtain measurements of work decrement, reminiscence, persistence and rate of work decrement.

On the basis of the statistical analysis and within the delimitations of the study, the following conclusions appear to be justified:

1. The extraverts demonstrated significantly more work decrement on the arm ergometer than did the introverts. A similar result that failed to reach significance was observed on the step test. However, in both instances the extraverts maintained a superior level of work output on the tasks.

On the pursuit rotor the introverts performed at a superior level. No statistical analysis of the amount of work decrement for this task was attempted.

It would appear that on the arm ergometer and step test reactive inhibition did not account for the amount of work decrement. Rather the extraverts demonstrated more work decrement because they performed at a superior level which resulted in a greater difference between the first and last minute. This difference was important in determining the work decrement score. Therefore, even though the hypothesis that extraverts would demonstrate significantly more work decrement was upheld, the reason was not necessarily due to inhibition build-up.

It was interesting to notice that on tasks that were of a non-learning nature (arm ergometer and step test) extraverts performed at a superior level. On the learning task (pursuit rotor) introverts were superior. The reason for the differences in task performance may have been due to learning or pain tolerance differences for the two groups.

2. It would appear that reminiscence as measured in the present experiment either is a meaningless phenomena or a satisfactory method of its determination has not yet been discovered. The fact that on all the tasks the extraverts demonstrated more reminiscence than introverts suggests that research continue to investigate the phenomena.

3. The step test persistence score was the only persistence score that was significantly different for the two groups.

It was interesting to notice that when a static stimulus-response task was used the introverts had longer persistence times. A reversal phenomena occurred when the dynamic stimulus-response task was used. This finding suggests a need for further investigation using different stimulus-response tasks. However, this reversal phenomena may have been the result of pain tolerance differences for the two groups.

4. No statistical analysis of rate of work decrement was attempted.

From inspection of the figures (1, 2A, 2B, 3A, 3B) it appears that the rate of work decrement did contribute significantly to the outcome of any group's performance. However, such factors as involuntary rests during the scheduled work period and differences in pain tolerance may have accounted for the similar rates of work decrement.

Recommendations

1. Pain tolerance should be equated or statistically controlled so that performance is not affected adversely for either personality group.

2. The type of stimulus-response should be investigated with respect to the personality dimension introversion-extraversion.

3. The phenomenon of reminiscence should be investigated on tasks which involve learning and very little physical pain and tasks which involve both. This should be done within both personality groups to see if there are differences.

4. Tasks of a physical nature should provide evidence that support Eysenck's theory (27), if his theory is acceptable as a predictor of performance. Further research using physical tasks will tend to either strengthen Eysenck's position or shed doubt on the whole construct of reactive inhibition.

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APPENDIX A

THE MAUDSLEY PERSONALITY INVENTORY

MAUDSLEY PERSONALITY INVENTORY

Instructions

Here are some questions regarding the way you behave, feel and act. After each question there is a "Yes," a "?" and a "No."

Try and decide whether "Yes" or "No" represents your usual way of acting or feeling; then put a circle around the "Yes" or "No." If you find it absolutely impossible to decide, put a circle round the "?", but do not use this answer except very occasionally. Work quickly, and don't spend too much time over any question; we want your first reaction, not a long drawn-out thought process! The whole questionnaire shouldn't take more than a few minutes. Be sure not to omit any questions. Now go ahead, work quickly, and remember to answer <u>every</u> question. There are no right or wrong answers, and this isn't a test of intelligence or ability, but simply a measure of the way you behave.

1. Are you happiest when you get involved in some project that calls for rapid action?

2. Do you sometimes feel happy, sometimes depressed, without any apparent reason?

3. Does your mind often wander while you are trying to concentrate?

4. Do you usually take the initiative in making new friends?

5. Are you inclined to be quick and sure in your actions?

6. Are you frequently "lost in thought" even when supposed to be taking part in a conversation?

7. Are you sometimes bubbling over with energy and sometimes very sluggish?

8. Would you rate yourself as a lively individual?

9. Would you be very unhappy if you were prevented from making numerous social contacts?

10. Are you inclined to be moody?

11. Do you have frequent ups and downs in mood, either with or without apparent cause?

12. Do you prefer action to planning for action?

13. Are your daydreams frequently about things that can never come true?
14. Are you inclined to keep in the background on social occasions?
15. Are you inclined to ponder over your past?
16. Is it difficult to "lose yourself" even at a lively party?
17. Do you ever feel "just miserable" for no good reason at all?
18. Are you inclined to be overconscientious?
19. Do you often find that you have made up your mind too late?
20. Do you like to mix socially with people?
21. Have you often lost sleep over your worries?
22. Are you inclined to limit your acquaintances to a select few?
23. Are you often troubled about feelings of guilt?
24. Do you ever take your work as if it were a matter of life or death?
25. Are your feelings rather easily hurt?
26. Do you like to have many social engagements?
27. Would you rate yourself as a tense or "highly-strung" individual?
28. Do you generally prefer to take the lead in group activities?
29. Do you often experience periods of loneliness?
30. Are you inclined to be shy in the presence of the opposite sex?
31. Do you like to indulge in a reverie (daydreaming)?
32. Do you nearly always have a "ready answer" for remarks directed at you?
33. Do you spend much time in thinking over good times you have had in the past?
34. Would you rate yourself as a happy-go-lucky individual?
35. Have you often felt listless and tired for no good reason?
36. Are you inclined to keep quiet when out in a social group?
37. After a critical moment is over, do you usually think of something you should have done but failed to do?

ANSWER SHEET

E = ? =

Last Name _____ Age _____
Given Names _____
Height _____ Weight _____
Address _____
Phone _____
P.E. Class - Days _____ Time ____
Faculty _____

1.	Yes	?	No	13.	Yes	?	No	25.	Yes	?	No	37.	Yes	?	No
2.	Yes	?	No	14.	Yes	?	No	26.	Yes	?	No	38.	Yes	?	No
3.	Yes	?	No	15.	Yes	?	No	27.	Yes	?	No	39.	Yes	?	No
4.	Yes	?	No	16.	Yes	?	No	28.	Yes	?	No	40.	Yes	?	No
5.	Yes	?	No	17.	Yes	?	No	29.	Yes	?	No	41.	Yes	?	No
6.	Yes	?	No	18.	Yes	?	No	30.	Yes	?	No	42.	Yes	?	No
7.	Yes	?	No	19.	Yes	?	No	31.	Yes	?	No	43.	Yes	?	No
8.	Yes	?	No	20.	Yes	?	No	32.	Yes	?	No	44.	Yes	?	No
9.	Yes	?	No	21.	Yes	?	No	33.	Yes	?	No	45.	Yes	?	No
10.	Yes	?	No	22.	Yes	?	No	34.	Yes	?	No	46.	Yes	?	No
11.	Yes	?	No	23.	Yes	?	No	35.	Yes	?	No	47.	Yes	?	No
12.	Yes	?	No	24.	Yes	?	No	36.	Yes	?	No	48.	Yes	?	No

APPENDIX B

RAW SCORES

RAW SCORES FOR INTROVERTS AND EXTRAVERTS ON THE PURSUIT ROTOR

Pre-Rest Trials							Post-Rest Trials				
	20-Second	Extravert		Introvert			20-Second	Extravert		Introvert	
Minutes	Intervals	Mean	S.D.	Mean	S.D.	Minutes	Intervals	Mean	S.D.	Mean	S.D.
1	1	1.93	1.69	2.16	1.50	1	1[x]	2.77	1.50	3.15	1.06
	2	4.40	3.46	4.77	2.97		2	6.37	2.84	7.32	2.58
	3	6.88	5.15	7.62	4.52		3	10.05	3.34	11.12	3.35
2	4	9.85	7.10	11.13	6.34		4	13.96	4.38	15.61	4.97
	5	12.90	9.40	14.09	7.92		5	18.23	5.55	19.94	5.83
	6	16.04	11.44	18.13	9.98		6	22.22	6.61	24.21	7.05
3	7	19.34	13.46	22.19	11.90	2	7	30.19	9.11	33.24	9.52
	8	22.65	15.47	25.95	13.59		8	38.03	11.86	42.01	11.46
	9	26.38	17.55	30.11	15.63		9	45.81	14.69	50.97	14.29
4	10	29.99	19.48	34.10	17.42	3	10	54.12	16.90	59.80	16.91
	11	33.59	21.48	38.40	19.41		11	62.03	19.06	67.96	19.46
	12	37.16	23.64	42.40	20.92		12	69.90	21.59	76.82	21.48
5	13[x]	38.86	24.62	44.41	21.99	4	13	77.51	23.55	85.19	23.76
	14	40.65	25.38	46.68	23.19		14	85.03	25.55	93.93	25.98
	15	42.58	26.42	48.77	24.09		15	92.33	27.58	102.38	27.83
	16	44.45	27.40	50.77	25.06	5	16	99.58	30.00	109.06	32.64
	17	45.83	28.12	52.99	26.17		17	105.97	32.25	118.97	32.62
	18	47.53	28.97	55.06	27.11		18	112.91	34.33	127.07	34.64

(Interpolated Rest Period)

(All units are in seconds.)

[x]A Single asterisk indicates a change in scoring that involves ten second intervals rather than twenty-second intervals. This procedure was necessary in order to obtain the recommended reminiscence measure.

[xx]A double asterisk indicates the scoring has returned to twenty-second intervals.

RAW SCORES FOR INTROVERTS AND EXTRAVERTS ON THE ARM ERGOMETER

Pre-Rest Trials						Post-Rest Trials				
Mins.	20-Second Intervals	Extravert Mean	Extravert S.D.	Introvert Mean	Introvert S.D.	Mins.	20-Second Intervals	Extravert Mean	Extravert S.D.	Introvert Mean	Introvert S.D.
	1	67.64	7.55	65.25	8.13			31.11[x]	3.49	30.92	6.16
	2	121.81	11.39	116.83	12.84			59.69	6.35	59.89	11.53
	3	167.08	15.19	157.50	16.65			86.63	8.77	87.56	15.63
	4	205.56	19.76	191.92	20.96			113.25	12.51	111.42	18.05
	5	240.75	26.40	222.31	27.43			135.25	15.10	133.08	20.48
	6	272.47	33.05	252.06	39.56			156.53	18.13	153.42	22.71
	7	304.33	40.25	280.28	40.58			195.17[xx]	24.40	191.14	27.00
	8	335.56	46.40	207.47	46.43			228.83	71.67	225.33	32.39
	9	367.75	53.23	335.19	52.11			262.14	39.03	258.22	38.31
	10	397.19	60.50	362.89	57.80			294.36	46.33	290.50	45.01
	11	427.19	67.24	389.89	63.05			327.11	53.85	322.00	50.46
	12	457.22	73.73	416.39	68.39			358.25	61.04	351.86	57.07
	13	486.86	80.73	443.19	74.85			390.19	68.37	381.69	63.39
	14	515.47	87.59	468.33	81.34			421.11	77.70	410.08	69.50
	15	544.42	93.48	494.61	86.48			452.61	85.34	438.81	75.69
	16	572.42	99.72	521.25	92.26			483.31	83.53	468.22	82.32
	17	604.03	104.88	574.94	98.58			512.44	99.94	496.36	88.18
	18	632.11	111.24	574.06	104.63			542.78	107.66	325.03	94.36
	19	660.56	115.54	596.24	113.78						
	20	688.17	120.64	625.03	117.07						
	21	715.92	126.39	650.06	123.42						
	22	742.54	131.19	675.25	129.38						
	23	771.72	137.67	700.75	135.77						
	24	799.08	144.06	725.83	141.53						
	25	825.67	180.28	751.11	148.24						
	26	851.56	155.84	775.81	154.08						
	27	877.53	162.13	800.08	160.49						
	28[x]	891.25	165.76	815.19	160.22						
	29	904.00	168.16	824.83	166.45						
	30	916.75	171.22	837.28	169.44						
	31	929.56	174.50	850.19	172.58						
	32	942.08	177.76	862.64	175.68						
	33	951.81	178.13	875.11	179.28						

(10 minute interpolated rest period)

(All units are in revolutions.)

[x]A single asterisk indicates a change in scoring that involves ten second intervals rather than twenty second intervals. This procedure was necessary in order to obtain the recommended reminiscence measure.

[xx]A double asterisk indicates the scoring has returned to twenty second intervals.

RAW SCORES FOR THE INTROVERTS AND EXTRAVERTS ON THE STEP TEST

Pre-Rest Trials						Post-Rest Trials				
Mins.	20-Second Intervals	Extravert Mean	Extravert S.D.	Introvert Mean	Introvert S.D.	Mins.	20-Second Intervals	Extravert Mean	Extravert S.D.	Introvert Mean	Introvert S.D.
	1	22.61	2.38	21.31	2.45		1[x]	12.14	1.67	11.06	1.45
	2	43.61	4.72	40.86	4.18		2	23.14	3.17	21.06	2.60
	3	64.28	6.66	60.39	6.13		3	33.89	4.33	30.81	3.69
	4	84.39	9.58	79.39	7.97		4	44.69	5.66	40.36	5.00
	5	103.83	11.36	97.47	10.17		5	55.06	7.21	50.06	6.29
	6	123.36	13.76	115.08	12.13		6	65.36	8.60	59.19	7.89
	7	142.39	16.33	132.53	14.31		7[x]	85.75	11.61	77.72	10.72
	8	161.14	18.68	149.31	16.75		8	104.14	15.02	94.83	14.11
	9	179.94	22.13	165.86	18.92		9	123.39	18.54	111.06	17.69
	10	197.97	24.71	182.03	21.53		10	142.50	21.87	127.14	20.70
	11	215.25	27.14	197.33	24.44		11	160.19	25.28	142.11	24.59
	12	231.94	29.88	211.69	27.20		12	177.47	29.23	156.69	28.33
	13[x]	240.56	31.14	219.42	28.63		13	194.39	32.80	170.94	31.61
	14	248.75	32.42	226.31	29.51		14	210.72	36.40	184.61	35.39
	15	256.72	33.85	233.06	30.81		15	226.92	40.47	197.72	38.95
	16	264.94	35.11	242.86	36.41		16	243.28	43.97	211.00	42.17
	17	273.14	36.47	249.39	37.74		17	258.94	47.47	223.94	44.84
	18	280.72	38.01	255.58	39.07		18	274.17	51.20	236.58	47.29

(Ten minute interpolated rest period)

(All units are in step ups.)

[x]A single asterisk indicates a change in scoring that involves ten second intervals rather than twenty second intervals. This procedure was necessary in order to obtain the recommended reminiscence measure.

SCORES FOR THE INTROVERTS ON THE ARM AND LEG PERSISTENCE TASKS[a]

Name	Arm	Leg	Name	Arm	Leg
Stollery	233	208	Bioletti	387	143
Klinger	231	81	Dittrich	306	191
d' Obrenan	206	49	Livingston	412	105
Kimmerly	229	36	Jobson	216	217
Smith	664	206	Pankhurst	271	47
Todevovitch	259	25	Gray	319	44
Parker	223	194	Nordstrom	260	155
Martin	254	124	Carlson	268	60
Lund	268	74	Friesen	373	50
Goble	270	72	Thoms	266	125
Sokolowski	322	123	Pickford	209	88
Hildebrandt	348	97	West	259	188
Botke	233	205	Pannekoek	168	110
Gagnon	335	282	Hayduk	187	87
Jacejko	201	78	Retallack	255	117
Chapman	246	63	Adamic	217	145
Davies	421	202	Dyck	322	229
Jones	163	117	Kelly	127	65

(All units are in seconds.)

SCORES FOR THE EXTRAVERTS ON THE ARM AND LEG PERSISTENCE TASKS[a]

Name	Arm	Leg	Name	Arm	Leg
Zulowski	150	181	Taschuk	140	98
Paley	253	96	Benge	223	45
McDonnild	365	226	Susat	230	215
McWally, F	108	72	Anderson	310	30
Balko, K.	170	127	Larson	264	69
Hamilton	316	107	Chetner	256	131
Chevet	252	36	Nichols	265	184
Amy	241	48	Beattie	362	115
Lunn	200	130	Negorski	278	121
Heyworth	265	110	Brown	320	58
Steel	141	104	Edmonson	204	105
Huffman	359	217	Borys	259	37
Radulski	223	34	Hany	356	145
Rutledge	142	76	Shur	146	54
Aubrey	320	112	Kupin	194	81
Douglas	217	101	Ross	339	202
Fries	237	153	Finnuty	265	117
Wolfe	182	133	Morrow	190	297

(All units are in seconds.)